CIBANO 500 PTM

User Manual

Manual Version: ENU 1007 05 05

The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing and are subject to change without prior notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present.

The user is responsible for every application that makes use of an OMICRON product.

OMICRON translates this manual from the source language English into a number of other languages. Any translation of this manual is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this manual shall govern.

Contents

About this manual

This User Manual provides information on how to use the *CIBANO 500* test system safely, properly and efficiently. The CIBANO 500 PTM User Manual contains important safety instructions for working with *CIBANO 500* and gets you familiar with operating *CIBANO 500*. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The CIBANO 500 PTM User Manual always has to be available on the site where *CIBANO 500* is used. The users of *CIBANO 500* must read this manual before operating *CIBANO 500* and observe the safety, installation, and operation instructions therein.

Reading the CIBANO 500 PTM User Manual alone does not release you from the duty to comply with all national and international safety regulations relevant to working on high-voltage equipment.

Safety symbols used

In this manual, the following symbols indicate safety instructions for avoiding hazards.

DANGER

Death or severe injury will occur if the appropriate safety instructions are not observed.

WARNING

Death or severe injury can occur if the appropriate safety instructions are not observed.

CAUTION

Minor or moderate injury may occur if the appropriate safety instructions are not observed.

NOTICE

Equipment damage or loss of data possible

1 Safety instructions

1.1 Operator qualifications

Working on high-voltage assets can be extremely dangerous. Consequently, only personnel qualified, skilled and authorized in electrical engineering and trained by OMICRON are allowed to operate *CIBANO 500* and its accessories. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on *CIBANO 500* must be under constant supervision of an experienced operator while working with the equipment. The operator is responsible for the safety requirements during the whole test.

Maintenance and repair of *CIBANO 500* and its accessories is only permitted by qualified experts at OMICRON service centers except for hardware update options delivered with the relevant Supplementary Sheet.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with *CIBANO 500* must comply with the internal safety instructions and additional safety-relevant documents.

In addition, observe the following safety standards, if applicable:

- EN 50191 (VDE 0104) "Erection and Operation of Electrical Test Equipment"
- EN 50110-1 (VDE 0105 Part 100) "Operation of Electrical Installations"
- IEEE 510 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing"

Moreover, observe all applicable regulations for accident prevention in the country and at the site of operation.

Before operating *CIBANO 500* and its accessories, read the safety instructions in this User Manual carefully.

Do not turn on *CIBANO 500* and do not operate *CIBANO 500* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *CIBANO 500* and its accessories is only permitted by qualified experts at OMICRON service centers (see "Support" on page 277).

1.2.2 Safety rules

Always observe the five safety rules:

► Disconnect completely.

► Secure against re-connection.

► Verify that the installation is dead.

► Carry out grounding and short-circuiting.

► Provide protection against adjacent live parts.

1.2.3 Safety accessories

OMICRON offers a range of accessories for added safety during the operation of our test systems. For further information and specifications, refer to the corresponding Supplementary Sheet or contact OMICRON Support.

1.3 Safe operation

When operating the *CIBANO 500* test system and its accessories, observe the following safety instructions.

1.3.1 Test equipment integrity

- ► Do not modify, extend, or adapt *CIBANO 500* and its accessories.
- ► Use only the *CIBANO 500* original accessories and cables and only use the OMICRON accessories together with OMICRON devices as described in this manual.
- ► Operate *CIBANO 500* and its accessories only under ambient conditions specified in "Technical data" in the CIBANO 500 User Manual.

1.3.2 *CIBANO 500*

- ► Use only adequately rated power cords.
- ► Supply *CIBANO 500* only from a power outlet with protective earth (PE).
- ► To run *CIBANO 500* at the maximum power level, we recommend mains overcurrent protection with a 16 A automatic circuit breaker.
- ► Position the measurement setup so that you can easily disconnect *CIBANO 500* from mains.
- ► Do not use extension cables on a cable reel to prevent overheating of the cord. Instead, run out the extension cord.
- ► Do not operate *CIBANO 500* without a solid connection to ground of at least 6 mm^2 cross-section. Ground *CIBANO 500* as close as possible to the operator.
- ► The warning symbol on the side panel of *CIBANO 500* (see 3.2.2 "Side panel" on page 16) indicates dangerous voltage on one of the *CIBANO 500* sockets, either from an internal source or from an external one, for example, from the station battery.
- ► After booting *CIBANO 500* either the red or the green warning light on the front panel should be on. If after booting both warning lights are on or off, *CIBANO 500* might be defective. In this case, do not use *CIBANO 500* and contact your regional OMICRON service center.
- ► Do not operate *CIBANO 500* and its accessories in the presence of explosives, dangerous gases or vapors.
- ► If *CIBANO 500* or its accessories do not seem to function properly, stop using them and contact your regional OMICRON service center.

1.3.3 Obey the safe area

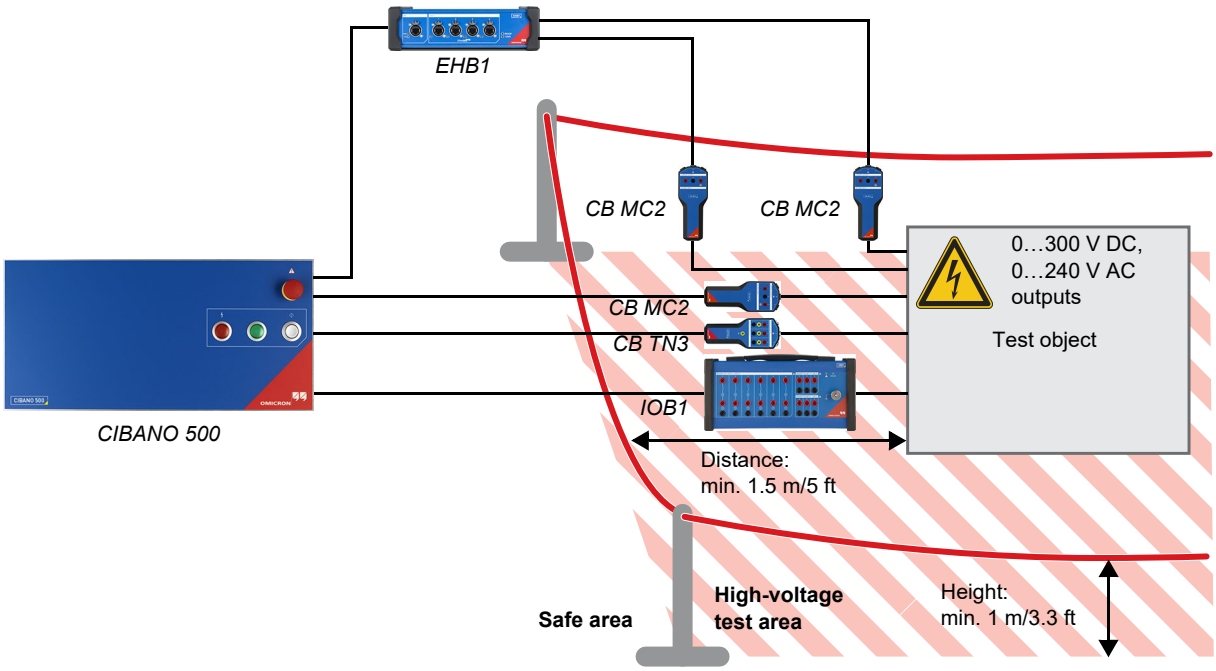


Figure 1-1: Example of the separation of the safe and high-voltage test areas

- ► Always stay in the safe area during test.
- ► Prior operation make sure that the test equipment is not mounted within the motion path of the circuit breaker. If needed, perform an operation prior mounting of test equipment (for example, motion sensors).
- ► For defining the appropriate high-voltage test area, consider any potential falling equipment (for example, the *CB MC2* modules or clamps) as well as wrong connected motion equipment.
- ► Position the test equipment on dry and solid surface.

1.3.4 De-energize the switchgear

- ► Identify your test object and make sure that you are using the corresponding wiring diagram.
- ► Disable any charging mechanism (for example, the motor).
- ► Ensure that the control circuit of the circuit breaker is de-energized (for example, the spring is discharged).
- ► Make sure that the circuit breaker cannot be tripped or closed remotely and locally (for example, use manual controls or distance orders).
- ► If you have to make connections to the auxiliary circuit (for example, to the trip or close coils):
  - ► Switch off or disconnect the test object from the station supply.
  - ► Apply the five safety rules.
  - ► Use terminal adapters to connect the test leads.
  - ► Only if required for testing, turn the supply back on.

1.3.5 Measurement setup

- ► Only use test leads and tools which provide full protection against direct contact.
- ► Always insert connectors completely and use the interlock mechanism.
- ► Press the **Emergency Stop** button on the *CIBANO 500* front panel while connecting the test leads to the test object.
- ► Do not insert objects (for example, screwdrivers) into any input/output socket.

1.3.6 Perform tests

- ► Stay in the safe area during test.
- ► Make sure that nobody is within the high-voltage test area.
- ► Warn people prior any operation to make them aware of any possible disturbances.

1.4 Orderly measures

The CIBANO 500 PTM User Manual or alternatively the e-book has always to be available on the site where *CIBANO 500* is operated.

The users of *CIBANO 500* must read this manual before operating *CIBANO 500* and observe the safety, installation, and operation instructions therein.

CIBANO 500 and its accessories may be used only as described in this User Manual. Any other use is not in accordance with the regulations. The manufacturer and the distributor are not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

Following the instructions provided in this User Manual is also considered part of being in accordance with the regulations.

Opening *CIBANO 500* or its accessories invalidates all warranty claims.

1.5 Disclaimer

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.6 Compliance statement

Declaration of conformity (EU)

The equipment adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) directive, the low voltage directive (LVD) and the RoHS directive.

FCC compliance (USA)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Declaration of compliance (Canada)

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

1.7 Recycling

This test set (including all accessories) is not intended for household use. At the end of its service life, do not dispose of the test set with household waste!

For customers in EU countries (incl. European Economic Area)

OMICRON test sets are subject to the EU Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE directive). As part of our legal obligations under this legislation, OMICRON offers to take back the test set and ensure that it is disposed of by authorized recycling agents.

For customers outside the European Economic Area

Please contact the authorities in charge for the relevant environmental regulations in your country and dispose the OMICRON test set only in accordance with your local legal requirements.

2 System requirements

Table 2-1: *Primary Test Manager* system requirements

Characteristic	Requirement (*recommended)
Operating system	**Windows 10 64-bit*** **Windows 8.1 64-bit***, **Windows 8 64-bit***, **Windows 7 SP1 64-bit*** and 32-bit
CPU	**Multicore system with 2 GHz or faster***, single-core system with 2 GHz or faster
RAM	min. 2 GB (**4 GB***)
Hard disk	min. 4 GB of available space
Storage device	DVD-ROM drive
Graphics adapter	Super VGA (1280×768) or higher-resolution video adapter and monitor[1]
Interface	Ethernet NIC[2], USB 2.0[3]
Installed software required for the optional Microsoft Office interface functions	**Microsoft Office 2016***, Office 2013, Office 2010, Office 2007

1. We recommend graphics adapter supporting Microsoft DirectX 9.0 or later.
2. For testing with *TESTRANO 600*, *CPC 100* and *CIBANO 500*. NIC = Network Interface Card. *TESTRANO 600, CPC 100* and *CIBANO 500* can be connected with RJ-45 connectors either directly to the computer or to the local network, for example, by using an Ethernet hub.
3. For testing with *FRANEO 800*

3 Introduction

3.1 Designated use

CIBANO 500, in conjunction with its accessories or as stand-alone unit, is a test system for commissioning and maintenance of circuit breakers. The following tests can be performed using *CIBANO 500* according to IEC and ANSI standards:

- Main contact resistance measurement (µΩ meter)
- Minimum pick-up voltage measurement of trip and close coils
- Motor current and voltage
- Main and resistive contact timing measurement
- Sending trip and close commands to perform different operations:
  - Open (O)
  - Close (C)
  - Reclose (OC)
  - Trip-free (CO)
  - Autoreclose (O-CO)
  - CO-CO
  - O-CO-CO
- Main contact dynamic resistance measurement enabling users to perform the operations listed earlier in this section
- Along with timing and dynamic resistance measurements, the following measurements can be included:
  - Trip and close coil current and voltage
  - Test of under voltage trip function
  - Main contact travel

CIBANO 500 operates only when connected to an external computer through an Ethernet connection. By using the *Primary Test Manager* software, you can define, parametrize, and execute various, partly automated tests.

3.2 Connections and operating controls

CIBANO 500 is available with two interface modules:

- EtherCAT®[1] module providing 4×EtherCAT® interfaces
- Auxiliary module providing 1×EtherCAT®, 3×AUX interfaces

The following figures describe the connections and operating controls of *CIBANO 500*.

1. EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

3.2.1 Front panel

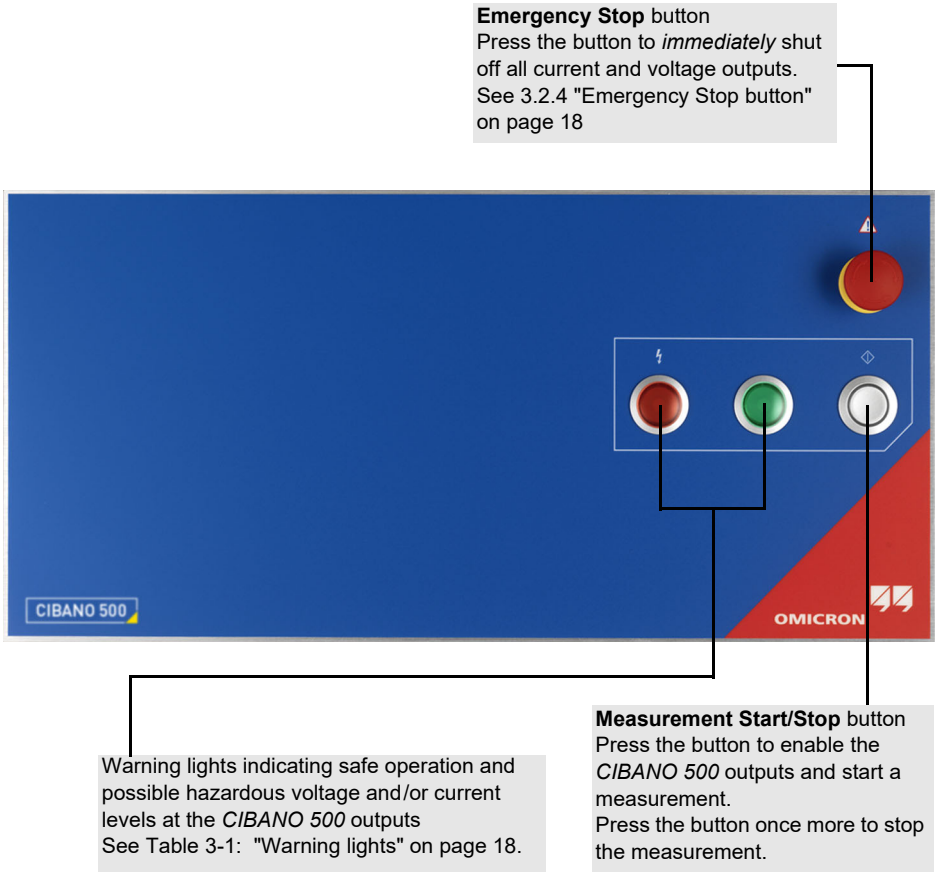


Figure 3-1: Front view of *CIBANO 500*

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not cover the warning lights (for example, with a computer) since the warning lights indicate possible hazards.
- ► Always observe the warning lights while working with *CIBANO 500*.

3.2.2 Side panel

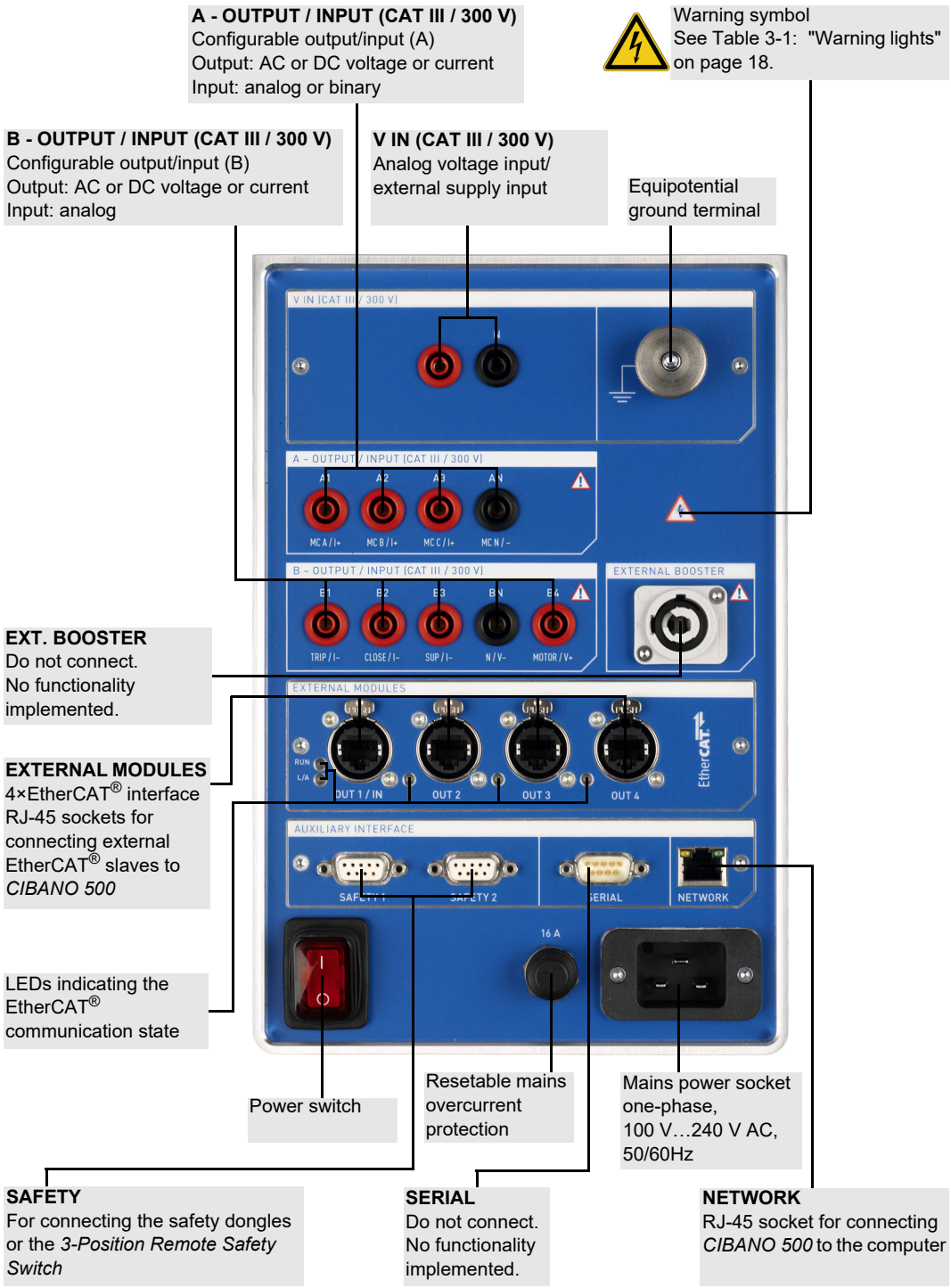


Figure 3-2: Side view of *CIBANO 500* with the EtherCAT® module

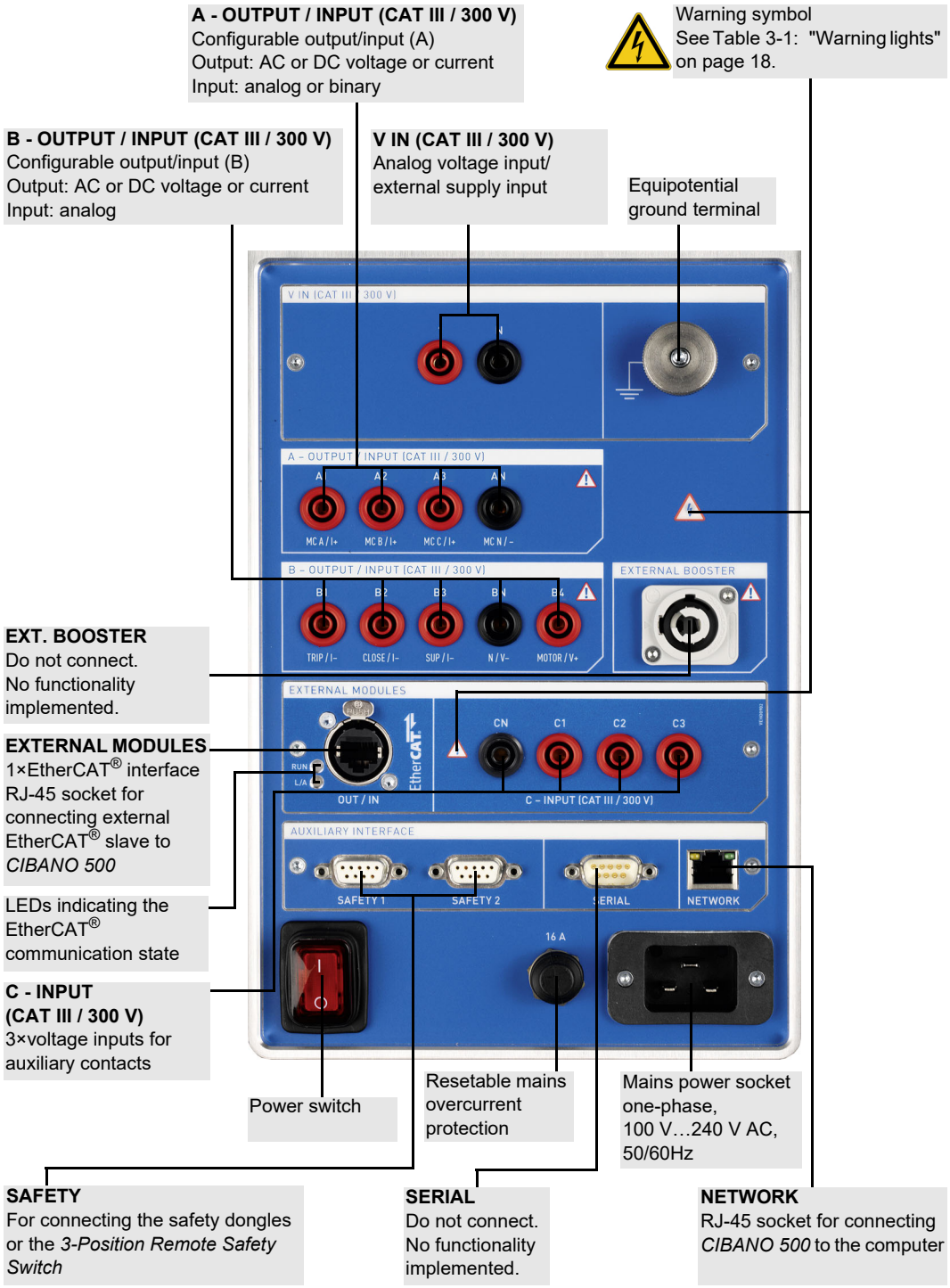


Figure 3-3: Side view of *CIBANO 500* with the Auxiliary module

3.2.3 Warning lights

CIBANO 500 provides the following warning lights to indicate safe operation and possible hazards.

Table 3-1: Warning lights

Warning light	Description	*CIBANO 500* state	Operating condition
	Green light on the front panel is on.	*CIBANO 500* is up and running in the stand-by mode.	Safe operating condition as long as no voltage is applied from outside (As long as the warning symbol on the side panel is off.)
	Blue ring on the **Measurement Start/Stop** button is on.	A test is prepared and ready to start.	
	Blue ring on the **Measurement Start/Stop** button is flashing.	A test is starting. Possibly there are hazardous voltage and/or current levels at the *CIBANO 500* outputs.	 **Dangerous operating condition**
	Red light on the front panel is flashing.	A test is running. Possibly there are hazardous voltage and/or current levels at the *CIBANO 500* outputs.	 **Dangerous operating condition**
	Warning symbol on the side panel is flashing.	There are hazardous voltage levels (> 42 V) at the *CIBANO 500* inputs/outputs independent of the measurement state.	 **Dangerous operating condition**

3.2.4 Emergency Stop button

Pressing the **Emergency Stop** button *immediately* shuts off all *CIBANO 500* outputs and stops the running measurement. After pressing the **Emergency Stop** button, *Primary Test Manager* does not allow starting a measurement.

To restart the measurement after the reason for the emergency stop has been resolved, release the **Emergency Stop** button by carefully turning it, click the **Start** button in *Primary Test Manager*, and then press the **Measurement Start/Stop** button.

For information about the *CIBANO 500* accessories, see "Accessories" in the CIBANO 500 PTM User Manual.

3.3 *Primary Test Manager*

Primary Test Manager is a control software for testing high-voltage assets with OMICRON test systems. *Primary Test Manager* provides a computer interface to the test set and assists you with the hardware configuration and test assessment.

With *Primary Test Manager*, you can create new jobs, execute prepared jobs, manage objects, create new manual tests, open existing manual tests, and perform tests. For a specified test, you can make measurements by just pressing the **Measurement Start/Stop** button on the front panel of the *CIBANO 500* test system. After you have performed a test, you can generate exhaustive test reports. *Primary Test Manager* runs on a computer and communicates with *CIBANO 500* through Ethernet interface.

For detailed information about *Primary Test Manager*, see the relevant chapters in the CIBANO 500 PTM User Manual.

3.4 Cleaning

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not clean the *CIBANO 500* test set when connected to the test object.
- ► Before cleaning *CIBANO 500* and its accessories, always disconnect the test object, accessories and connection cables.

To clean *CIBANO 500* and its accessories, use a cloth dampened with isopropanol alcohol.

4 Functional scheme

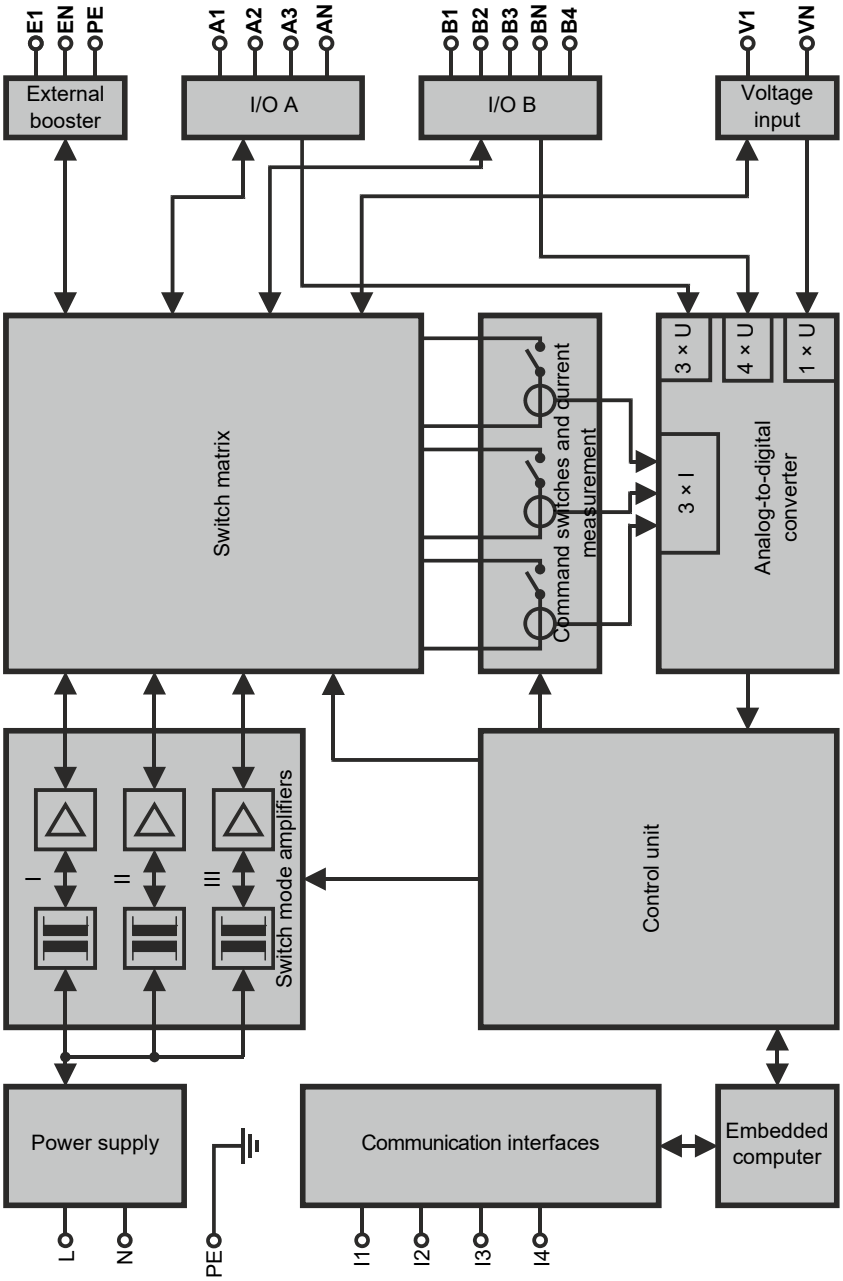


Figure 4-1: *CIBANO 500* with the EtherCAT® module

The following table describes the terminals of the functional scheme of *CIBANO 500* with the EtherCAT® module.

Table 4-1: Terminals of *CIBANO 500* with the EtherCAT® module

Terminal	Description
Mains interface	
L	Mains phase
N	Mains neutral
PE	Equipotential ground
Communication interfaces	
I1	4 × external EtherCAT® modules
I2	1 × Ethernet
I3	1 × serial
I4	2 × safety
External booster	
E1	External booster phase
EN	External booster neutral
PE	Equipotential ground
I/O A	
A1	Input/output A1
A2	Input/output A2
A3	Input/output A3
AN	Input/output AN
I/O B	
B1	Input/output B1
B2	Input/output B2
B3	Input/output B3
BN	Input/output BN
B4	Input/output B4
Voltage input	
V1	Voltage input 1
VN	Voltage input N

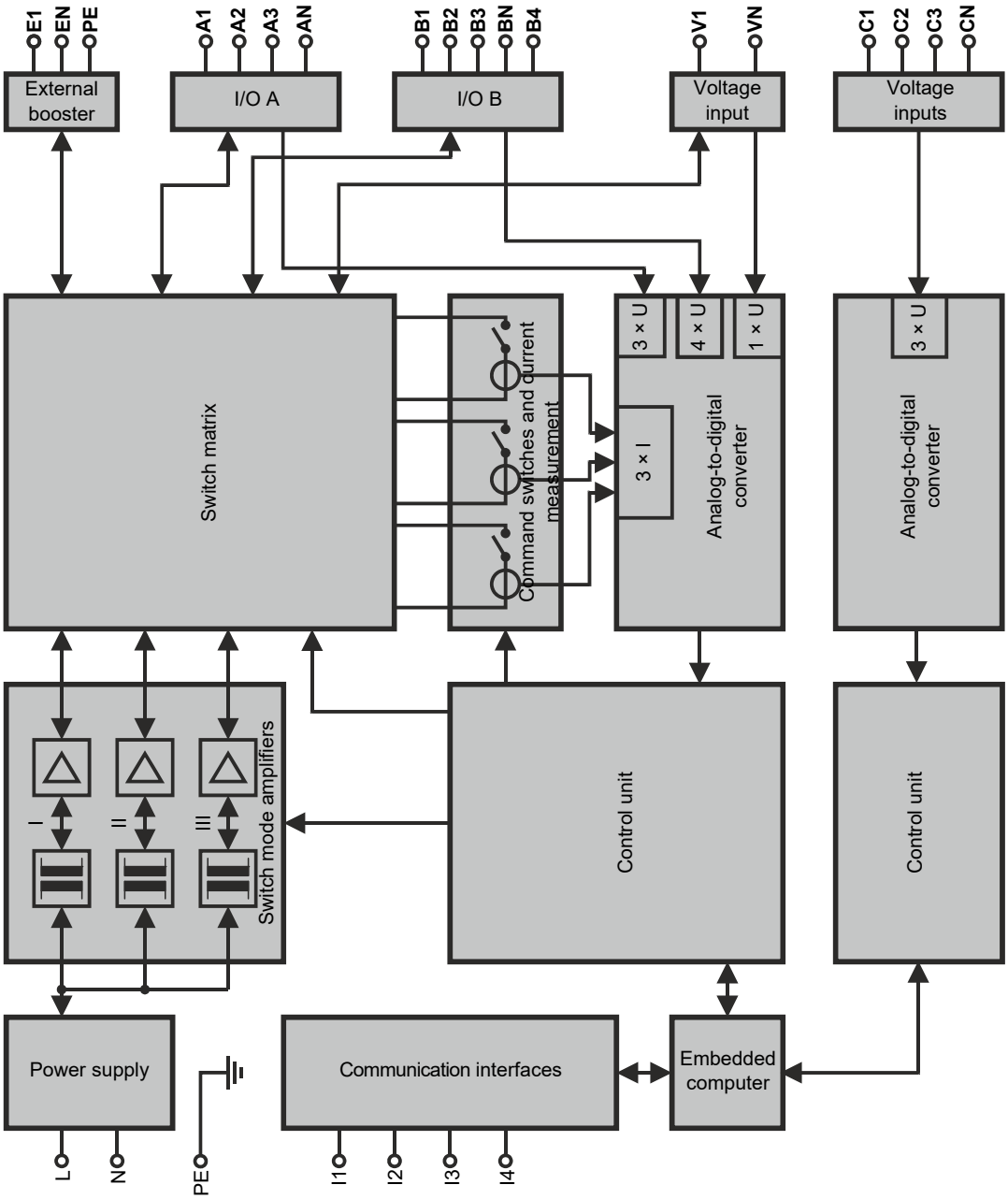


Figure 4-2: *CIBANO 500* with the Auxiliary module

The following table describes the terminals of the functional scheme of *CIBANO 500* with the Auxiliary module.

Table 4-2: Terminals of *CIBANO 500* with the Auxiliary module

Terminal	Description
Mains interface	
L	Mains phase
N	Mains neutral
PE	Equipotential ground
Communication interfaces	
I1	1 × external EtherCAT® module
I2	1 × Ethernet
I3	1 × serial
I4	2 × safety
External booster	
E1	External booster phase
EN	External booster neutral
PE	Equipotential ground
I/O A	
A1	Input/output A1
A2	Input/output A2
A3	Input/output A3
AN	Input/output AN
I/O B	
B1	Input/output B1
B2	Input/output B2
B3	Input/output B3
BN	Input/output BN
B4	Input/output B4
Voltage inputs	
C1	Voltage input C1
C2	Voltage input C2
C3	Voltage input C3
CN	Voltage input CN
Voltage input	
V1	Voltage input 1
VN	Voltage input N

4.1 Voltage operating mode

The following figure explains the *CIBANO 500* voltage operating mode.

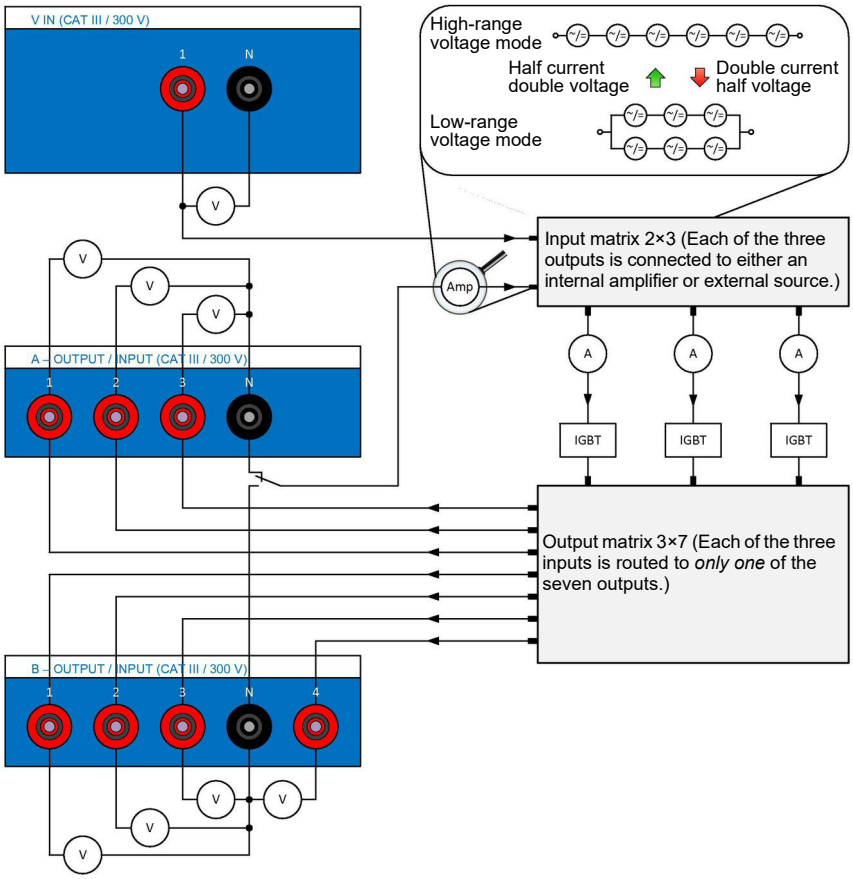


Figure 4-3: The *CIBANO 500* voltage operating mode

Figure 4-3: "The CIBANO 500 voltage operating mode" shows the switching of the internal amplifiers in the voltage operating mode. In this case seven channels are available: **A1**…**A3** and **B1**…**B4**. Three channels of these seven channels can be used synchronously but all either of the section **A** or the section **B**. You cannot use the outputs of both sections at the same time but only sequentially, one after each other.

The driving source of the channel can be either the internal amplifiers or an external source connected to the **V IN** input of *CIBANO 500*. Depending on the settings of the firmware the amplifier matrix in Figure 4-3 connects inputs of the IGBTs (integrated gate bipolar transistors) to either the internal amplifier or the external source. The socket matrix then routes the output of each of the three IGBTs to the seven channels on the *CIBANO 500* side panel. To apply a voltage to a socket the corresponding IGBT is closed.

Note: There is a certain voltage drop across the IGBTs which is not controlled by the source due to the design related issues of the device.

In comparison to the current operating mode (see 4.2 "Current operating mode" later in this chapter) in which you can select three individual amplifiers the voltage operating mode provides only one single amplifier composed of six amplifiers. Consequently, you cannot apply two different voltages at the same time but only sequentially. In the voltage operating mode, two modes are available: the high-range voltage mode and the low-range voltage mode. For the output data of the voltage operating mode, see 20.2 "CIBANO 500 specifications" on page 248.

The current measurement is performed in series to each IGBT. The voltage is measured for each output individually.

4.2 Current operating mode

The following figure explains the *CIBANO 500* current operating mode.

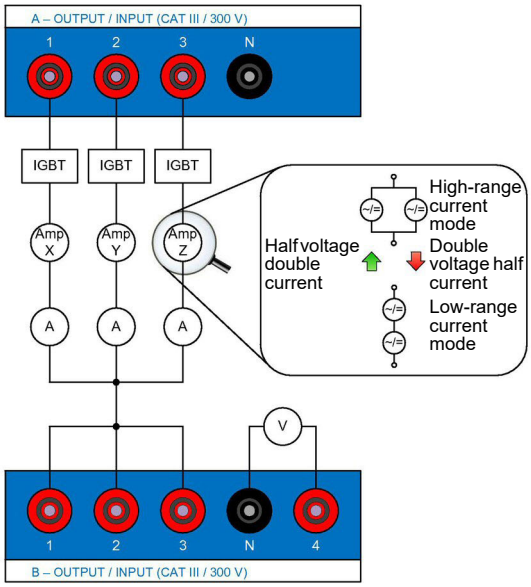


Figure 4-4: The *CIBANO 500* current operating mode

Figure 4-4: "The CIBANO 500 current operating mode" shows the switching of the internal amplifiers in the current operating mode. In this case three independent current channels are available: **A1**, **A2** and **A3**. These channels are driven by the amplifiers Amp X, Amp Y and Amp Z. The sockets **B1**, **B2** and **B3** are connected to the same potential, in this case to the neutral potential of the channels **A1**, **A2** and **A3**.

In the current operating mode, two modes are available: the high-range current mode and the low-range current mode. Each channel is equipped with two amplifiers giving a total of six amplifiers which can either be switched in parallel (high-current mode) or in series (low-current mode). For the output data of the current operating mode, see 20.2 "CIBANO 500 specifications" on page 248.

5 Installation

This section describes how to put the *CIBANO 500* test system into operation. The *CIBANO 500* operation is controlled by the *Primary Test Manager* software. Consequently, before operating *CIBANO 500*, you must install *Primary Test Manager* and connect *CIBANO 500* to a computer.

5.1 Connect *CIBANO 500* to the computer

CIBANO 500 communicates with the computer through Ethernet interface. To connect *CIBANO 500* to the computer:

1. Connect the delivered Ethernet cable to the **NETWORK** socket on the *CIBANO 500* side panel.
2. Connect the other end of the Ethernet cable to the Ethernet connector of your computer.
3. Check whether the safety dongels shipped with *CIBANO 500* are plugged in and locked in the **SAFETY** connectors on the side panel (see 3.2.2 "Side panel" on page 16).

5.2 Power up *CIBANO 500*

To power up *CIBANO 500*:

1. Connect the equipotential ground terminal of *CIBANO 500* (see 3.2.2 "Side panel" on page 16) to ground as close as possible to the operator.
2. Plug the power cable into the power socket on the *CIBANO 500* side panel.
3. Plug the mains plug of the power cable into the power outlet.
4. Press the power switch on the *CIBANO 500* side panel.

5.3 Install *Primary Test Manager*

For the minimum requirements your computer needs to run *Primary Test Manager*, see 2 "System requirements" on page 13.

► To install *Primary Test Manager*, put the delivered *Primary Test Manager* DVD in the DVD drive of your computer and follow the instructions on the screen.

5.4 Start *Primary Test Manager* and connect to *CIBANO 500*

► To start *Primary Test Manager*, click **Start** on the task bar, and then click **OMICRON Primary Test Manager**, or double-click the **OMICRON Primary Test Manager** icon on the desktop.

► To connect to *CIBANO 500*, select the device from the list, and then click **Connect**.

Figure 5-1: Connecting to *CIBANO 500*

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then do one of the following:

► Click **More** beneath the **Connect** button, and then click **Refresh**.

► Press F5.

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in "Troubleshooting" in the CIBANO 500 PTM User Manual.

Alternatively, you can manage the connection to *CIBANO 500* in the *Primary Test Manager* status bar (see "Status bar" in the CIBANO 500 PTM User Manual).

There is embedded software and firmware in *CIBANO 500* and firmware in each of the *CB MC2*, *CB TN3* and *IOB1* modules. The embedded software upgrade requires a special procedure, all other upgrades can be done during normal operation.

5.4.1 Upgrade the *CIBANO 500* embedded software

The *CIBANO 500* embedded software must be compatible with *Primary Test Manager*. You can upgrade the *CIBANO 500* embedded software in the *Primary Test Manager* home view (see "Home view" in the CIBANO 500 PTM User Manual).

► To upgrade the *CIBANO 500* embedded software, select the device you want to upgrade from the list, and then click **Connect**. *Primary Test Manager* will prompt you to upgrade the *CIBANO 500* embedded software, if necessary.

Alternatively, you can proceed as follows:

1. In the home view, select the device you want to upgrade from the list.
2. Click **More** beneath the **Connect** button, and then click **Update device software**.
3. In the **Select CIBANO Update Image** dialog box, double-click the embeddedImage.tar file.

If you encounter problems when upgrading the *CIBANO 500* embedded software, proceed as described in "Troubleshooting" in the CIBANO 500 PTM User Manual.

5.4.2 Upgrade the *CIBANO 500* firmware

After upgrading the *CIBANO 500* embedded software, you might need to upgrade also the firmware of *CIBANO 500* or the firmware of the *CB MC2*, *CB TN3* and *IOB1* modules. If a firmware upgrade is necessary, the following notification bar appears after you selected a test.

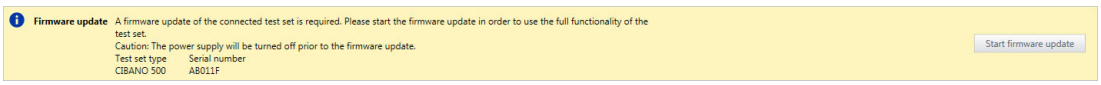


Figure 5-2: Upgrading the firmware of *CIBANO 500* and connected external modules

► To upgrade the *CIBANO 500* firmware, click **Start firmware update**.

5.4.3 Open the device web interface

On the device website, you can upgrade the device embedded software, get log files, roll back software images, reboot the device and manage license files.

To open the device web interface:

1. In the home view, select the device from the list.
2. Click **More** beneath the **Connect** button, and then click **Open device web interface**.
   A website with the IP address of the device opens in the default web browser.

5.5 Connect *CIBANO 500* to the test object

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect *CIBANO 500* to a test object before isolating the test object according to the five safety rules.
- ► Always obey the five safety rules (see 1.2.2 "Safety rules" on page 8) and all additional relevant laws and internal safety standards when connecting *CIBANO 500* to a test object.

You can connect *CIBANO 500* to the test object without disconnecting other parts of the station or with complete disconnection from the station as shown in the following figure.

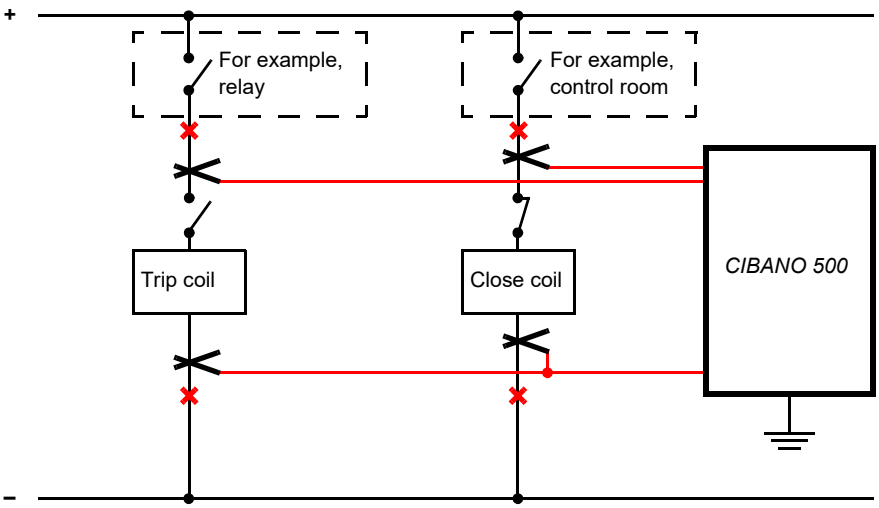


Figure 5-3: Principal connection of *CIBANO 500* to the test object

To connect *CIBANO 500* to the test object:

1. Connect the equipotential ground terminal of *CIBANO 500* (see 3.2.2 "Side panel" on page 16) to ground as close as possible to the operator.

2. Do one of the following:
   - ► Assure that the points of connection carry no voltage. Voltage on the connection points can impact the safety of the operator but poses no danger to the test set. Clamp *CIBANO 500* to the circuit breaker's trip and close coils without disconnecting other parts of the station. The advantage of this method is that you do not need to modify the wiring of the circuit breaker to the station. The disadvantage is that it is difficult to ensure that there is no voltage on the points of connection. Connecting *CIBANO 500* while voltage is present on the connection point requires special safety precautions depending on the company and national standards and is explicitly not recommended by OMICRON.
   - ► Disconnect the circuit breaker at the points marked by the red crosses completely from the substations. Then clamp *CIBANO 500* to the circuit breaker's trip and close coils. You can often do it easily on medium-voltage breakers by removing a single plug and therefore recommended for maximum safety.

The following figures show typical *CIBANO 500* measurement setups for testing medium-voltage and high-voltage circuit breakers. Depending on the *Primary Test Manager* settings, many other configurations are possible.

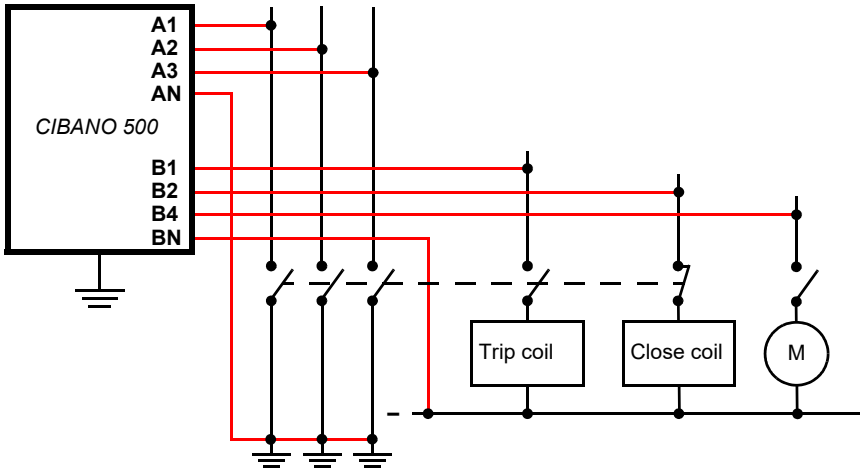


Figure 5-4: Typical measurement setup for the Timing test on medium-voltage circuit breakers with complete disconnection from the station

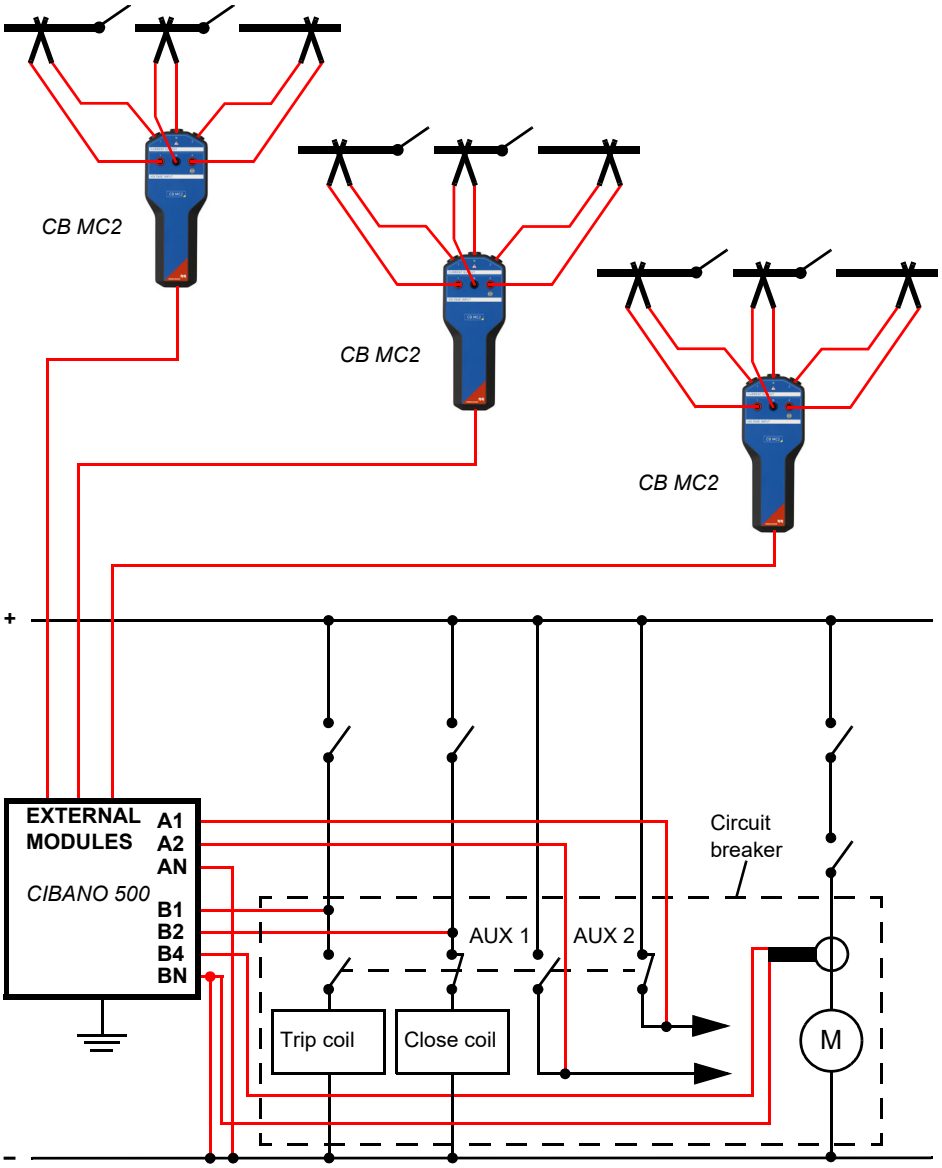


Figure 5-5: Typical measurement setup for testing high-voltage circuit breakers

6 Home view

After starting *Primary Test Manager*, the home view opens. In the home view, you can select different user tasks designed to support you during diagnostic testing and management of test objects and test data.

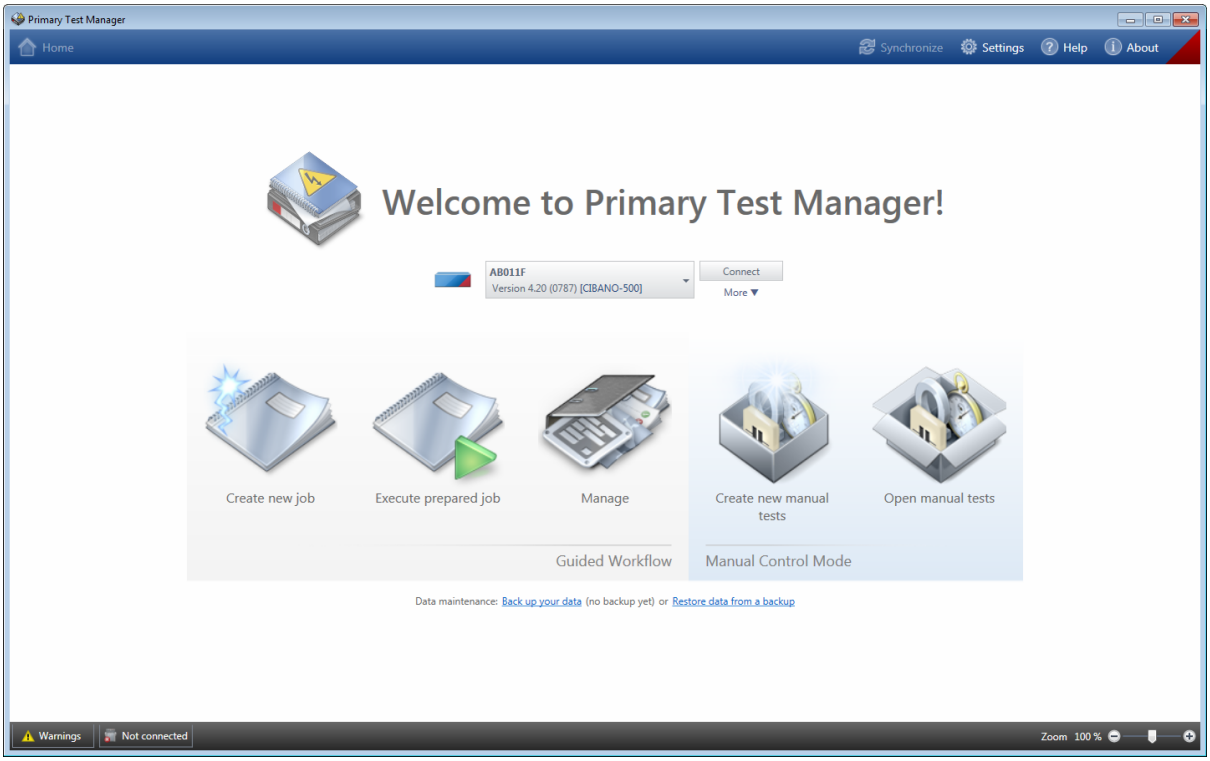


Figure 6-1: *Primary Test Manager* home view

Primary Test Manager processes data of different workflow importance. This is indicated by balloons of different categories as described in the following table.

Table 6-1: Data importance categories

Balloon	Category	Description
	Mandatory	Indicates data required for performing tests.
	Recommended	Indicates data supporting the *Primary Test Manager* workflow.
	Information	Contains descriptive information.

Primary Test Manager supports the following user tasks.

Table 6-2: Selecting the user tasks

Button	Description	Action
	Create new job	Click the **Create new job** button to start the guided test workflow (see 7 "Create new job" on page 46).
	Execute prepared job	Click the **Execute prepared job** button to execute a prepared job (see 8 "Execute prepared job" on page 65).
	Manage	Click the **Manage** button to manage locations, assets, jobs, and reports (see 9 "Manage objects" on page 66).
	Create new manual tests	Click the **Create new manual tests** button to create a new manual test (see 10 "Create new manual tests" on page 73)
	Open manual tests	Click the **Open manual tests** button to open a manual test (see 11 "Open manual tests" on page 77)

6.1 Title bar

Note: The title bar is displayed in any *Primary Test Manager* view.

The following table describes the title bar commands.

Table 6-3: Title bar commands

Command	Action
Home	Click **Home** to move from any view to the home view.
Synchronize[1]	Click **Synchronize** to synchronize your local database with the *Primary Test Manager* server database (see 6.4 "Data synchronization" on page 43).
Settings	Click **Settings** to open the **Settings** dialog box (see 6.1.1 "Settings" later in this chapter).
Help	Click **Help** to open the *CIBANO 500* technical documentation and send data to OMICRON Technical Support (see 6.1.2 "Help" on page 39).
About	Click **About** to open the **About Primary Test Manager** dialog box (see 6.1.3 "About" on page 40).

1. Only enabled with the appropriate license.

6.1.1 Settings

In the **Settings** dialog box, you can make a number of *Primary Test Manager* settings to match your regional conventions, manage the job templates, and set the *Primary Test Manager* server settings for data synchronization (see 6.4 "Data synchronization" on page 43). To open the **Settings** dialog box, click **Settings** in the title bar.

NOTICE

Equipment damage or loss of data possible

Changing the settings in the **Settings** dialog box affects all data in *Primary Test Manager*.

- ► Only change settings if you are qualified to do so.
- ► Review your changes before clicking **OK**.

Note: After changing a setting, you must restart *Primary Test Manager* for the setting to take effect.

General

On the **General** tab, you can make general settings of *Primary Test Manager*.

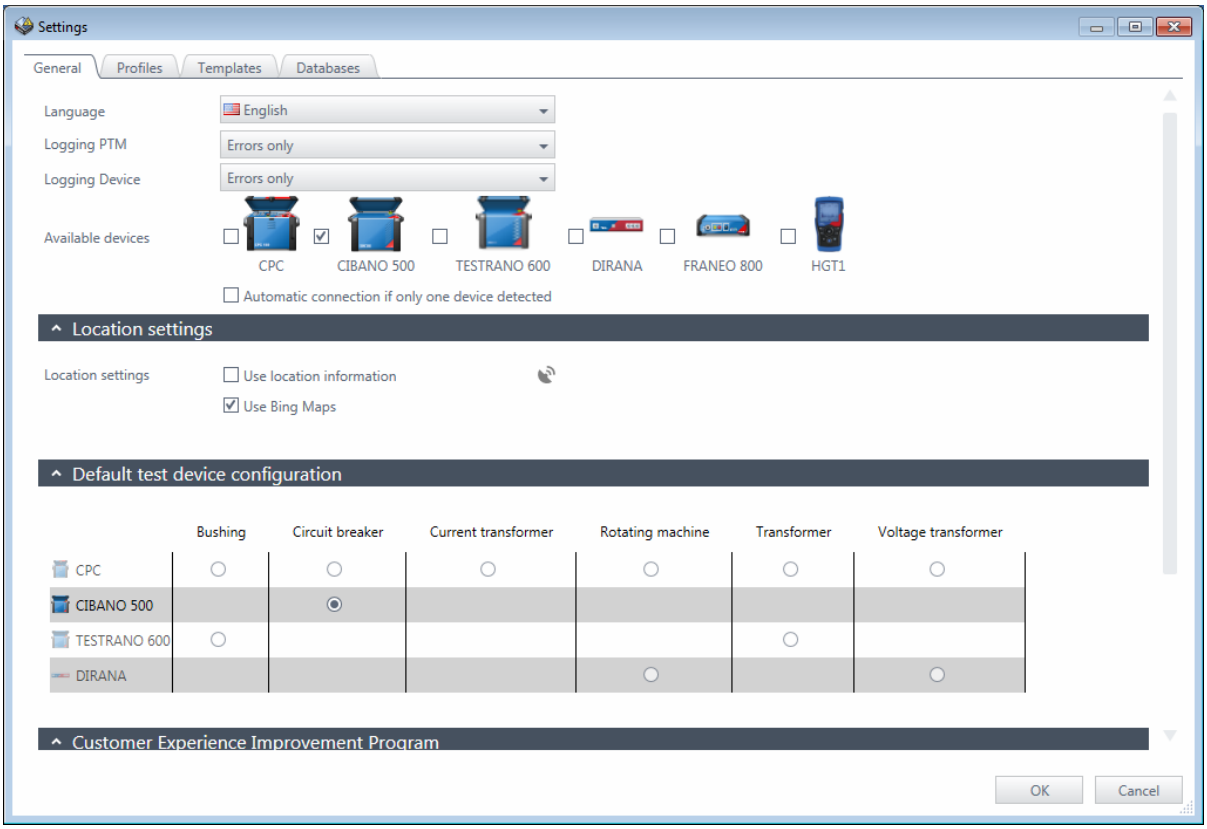


Figure 6-2: **General** tab

► To set the *Primary Test Manager* language, select your preferred language from the **Language** list.

► To set the logging level, select your preferred level from the **Logging PTM** and **Logging Device** lists. The logging function provides information to help find the cause for an error in cooperation with an OMICRON support engineer. **Logging PTM** collects information on PTM while **Logging Device** focuses on your device.

Note: Log files do not contain any personal information.

Table 6-4: Logging levels

Logging level	Description
Disabled	Logging is disabled.
Errors only	Only errors are logged. Recommended setting
Info	Errors and some additional information are logged.
Full	All software-related activities are logged. **Note:** Full logging will slow down software performance.

► To set the types of available devices, select the respective check boxes.

Note: If no device is connected, *Primary Test Manager* will automatically compile the test list (see section 7.5 "Test view" on page 60) for the selected default test set.

Note: Select the **Automatic connection if only one device detected** check box if only one device is available. Then *Primary Test Manager* connects to the available device automatically.

The **Locations settings** options do not apply to testing with *CIBANO 500*.

Under **Default test device configuration**, *Primary Test Manager* displays the default devices for testing different assets. If several devices are available for an asset, you can set your preferred test system as default device for that asset.

The **Customer Experience Improvement Program** collects information about how you use *Primary Test Manager* without interrupting you. This helps OMICRON identify which features to improve. No information collected is used to identify or contact you. We encourage you to join the program to help improve *Primary Test Manager*.

Profiles

On the **Profiles** tab, you can set your profile, the default rated frequency, the loss index, the units of your own profiles, and make the test system settings.

Note: The dissipation factor and the tangent delta are identical characteristics of the primary asset under test. For your convenience, with *Primary Test Manager* you can use your preferred naming.

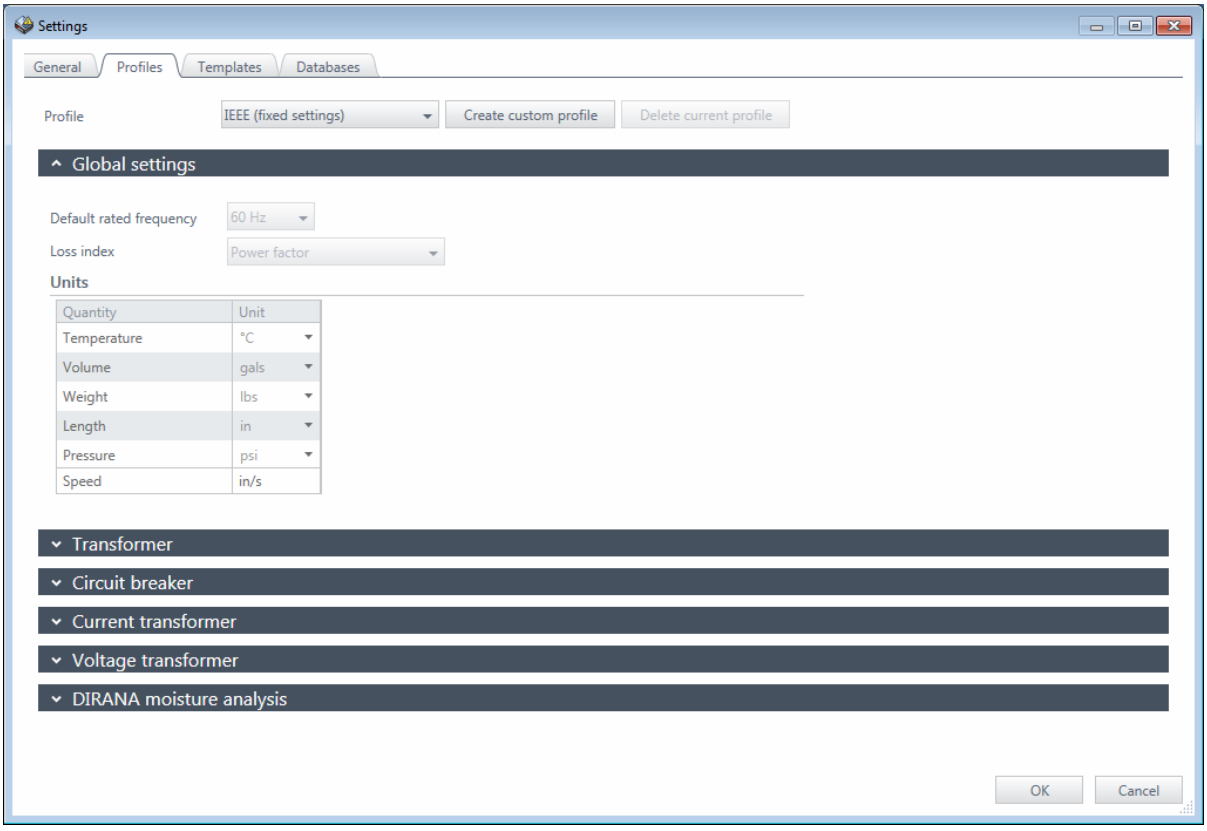


Figure 6-3: **Profiles** tab: **Global settings**

With *Primary Test Manager*, you can use predefined profiles and create your own profiles for naming conventions.

Note: *Primary Test Manager* sets the default profile according to the regional settings of your computer.

► To set a profile, select the profile you want to use from the **Profiles** list.

To create your own profile:

1. Click **Create custom profile**.
2. In the **Create custom profile** dialog box, type the profile name, and then click **Create**.
3. Under **Global settings**, set the default rated frequency, the loss index, and your preferred units.
4. Under **Circuit breaker**, set the circuit breaker terminal name schemes.

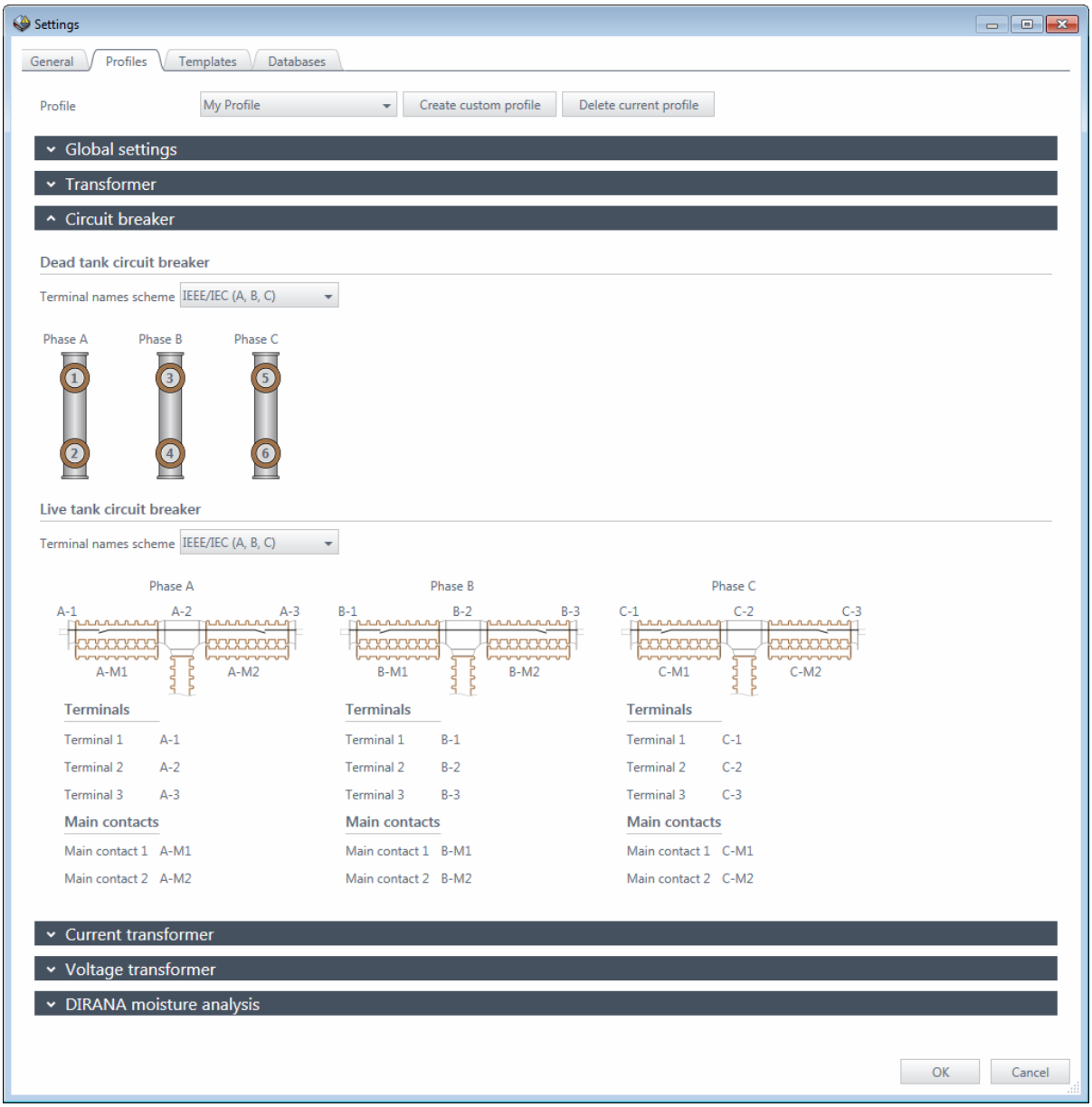


Figure 6-4: **Profiles** tab: **Circuit breaker**

5. Click **OK** to close the **Settings** dialog box.

► To delete your own profile, select the profile from the **Profiles** list, and then click **Delete current profile**.

Templates

On the **Templates** tab, you can edit, import and export job templates. For information on how to process the templates, see 7.5.4 "Processing templates" on page 69.

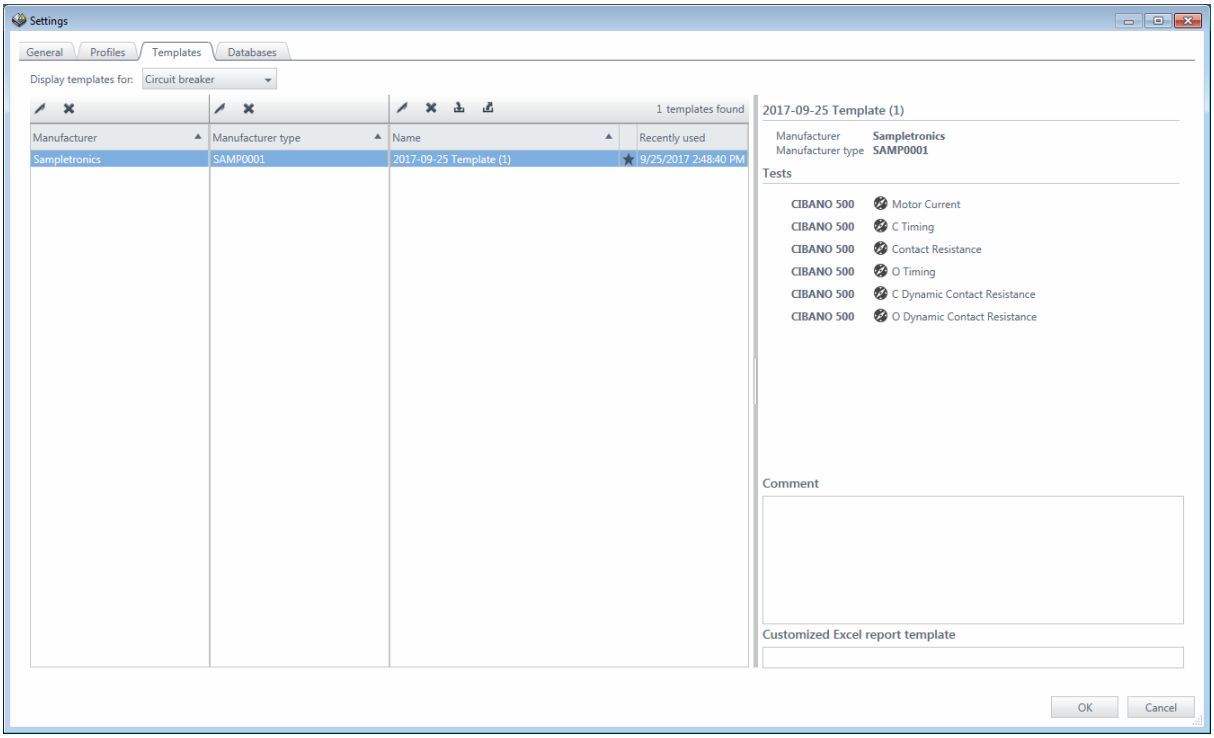


Figure 6-5: **Templates** tab

To manage the job templates, select **Circuit breaker** from the **Display templates for** list, and then do one of the following:

► To edit the manufacturer, the manufacturer type or the template properties (manufacturer, manufacturer type, name, comment), click the respective **Edit** button .

► To delete a manufacturer and all associated templates, select the manufacturer, and then click the corresponding **Delete** button .

► To delete a manufacturer type and all associated templates, select the manufacturer type, and then click the corresponding **Delete** button .

► To delete a template, select the template, and then click the corresponding **Delete** button .

► To export a template, select the template, and then click the **Export** button .

► To import a template, click the **Import** button , and then browse to the template you want to import.

► To set a template as favorite, click the corresponding favorite flag .

Note: The first template you associate with a manufacturer type is set as favorite by default.

The right pane of the template workspace displays the template preview.

Databases

On the **Databases** tab you can create, manage and switch between different databases for *Primary Test Manager*. Under **Properties**, you can edit the database name and adjust the server settings for *DataSync*. For more information, see 6.4.1 "Server settings" on page 43.

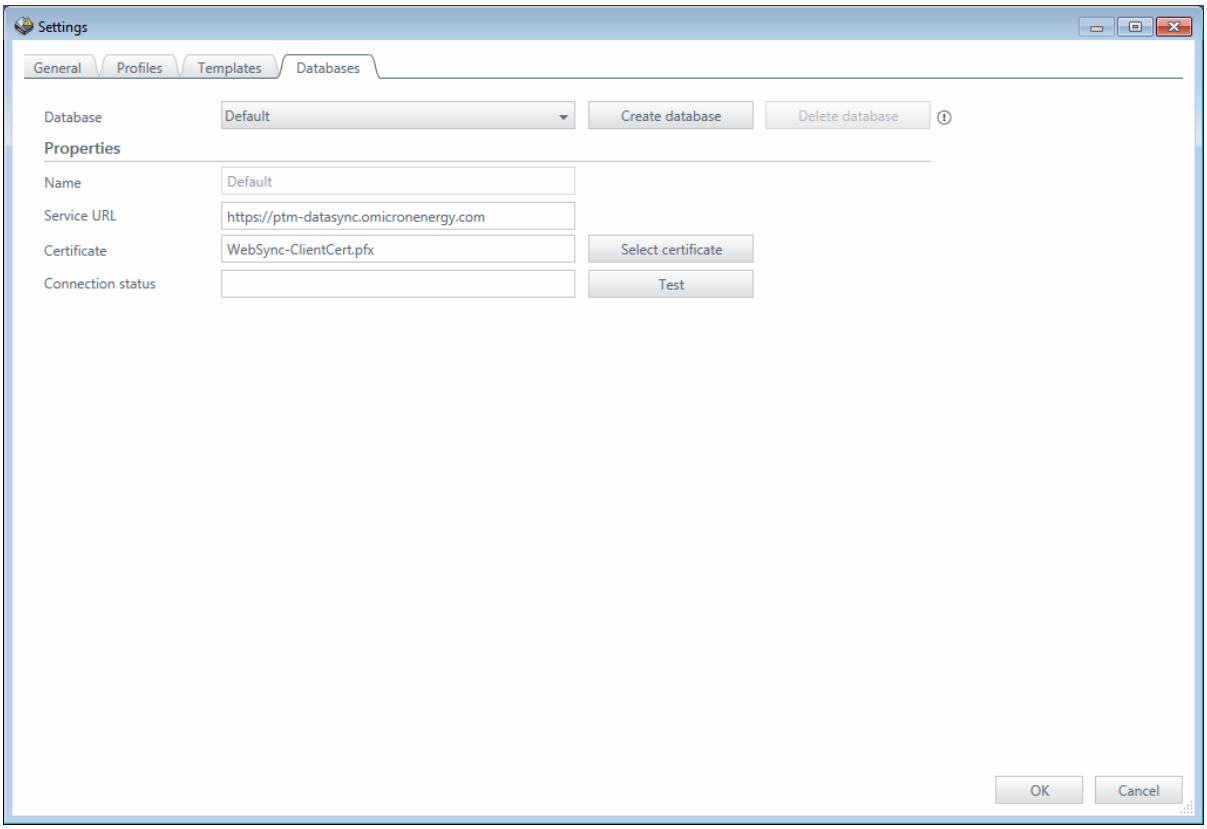


Figure 6-6: **Databases** tab

6.1.2 Help

In the **Help** dialog box, you can get the relevant information about *CIBANO 500* and data synchronization, and send data to OMICRON Technical Support. To open the **Help** dialog box, click **Help** in the title bar.

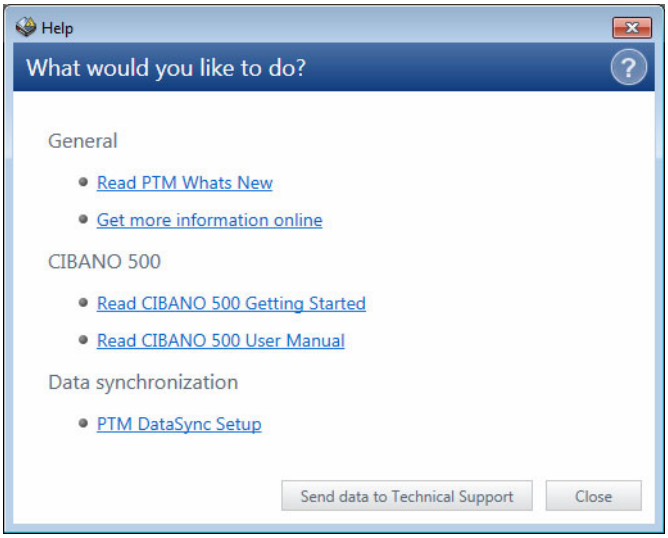


Figure 6-7: **Help** dialog box

6.1.3 About

In the **About Primary Test Manager** dialog box, you can enter a license key to upgrade your *Primary Test Manager* and enhance its functionality by installing additional features. To open the **About Primary Test Manager** dialog box, click **About** in the title bar.

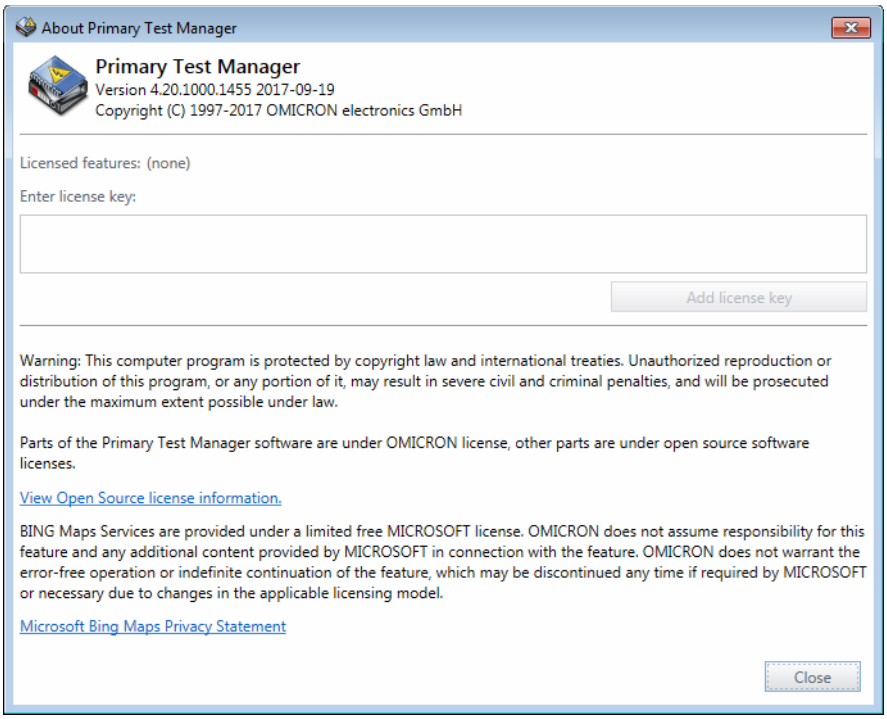


Figure 6-8: **About Primary Test Manager** dialog box

To activate a license, enter the license key in the **About Primary Test Manager** dialog box, and then click **Add license key**. For detailed information about the *Primary Test Manager* licensing, contact your OMICRON local sales representative or distributor.

6.2 Status bar

Note: The status bar is displayed in any *Primary Test Manager* view.

The status bar displays information about the status of the test system and provides access to the zoom function. The following table describes the statuses of the test system.

Table 6-5: Test system statuses

Symbol	Status
	*CIBANO 500* is connected.
	*CIBANO 500* is not connected.

In the status bar, you can connect to and disconnect from a test system, and show and refresh the test set information.

To connect to a test system:

1. Right-click the *CIBANO 500* symbol in the status bar, and then click **Connect**.

Figure 6-9: **Connect to device** dialog box

2. In the **Connect to device** dialog box, select the test system from the list, and then click **Connect**.

Note: Select the **Automatic connection if only one device detected** check box if only one device is available. Then *Primary Test Manager* connects to the available device automatically.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** beneath the **Connect** button.
2. Click **Refresh**.
3. In the **Connect to device** dialog box, select the test system from the list, and then click **Connect**.

After you have connected to the test system, the following dialog box appears.

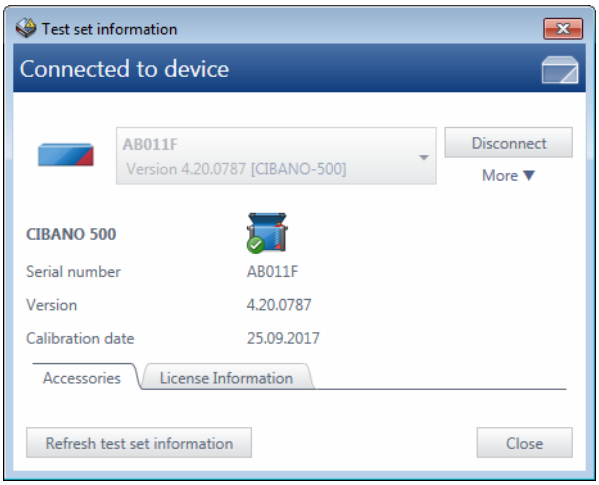


Figure 6-10: **Connected to device** dialog box

Note: For connecting to a test system not included in the list, see 19.1 "Connecting to CIBANO 500" on page 243.

After you have connected to a test system, right-click the *CIBANO 500* symbol in the status bar, and then do one of the following:

► To disconnect from a test system, click **Disconnect**.

► To display information about the connected test system, click **Show test set information**.

► To update the test set information, click **Refresh test set information**.

Note: You can open the **Connect to device** and the **Connected to device** dialog boxes also by double-clicking the *CIBANO 500* symbol.

6.3 Data backup and restoring

We strongly recommend backing up your data in the *Primary Test Manager* database on a regular basis. *Primary Test Manager* reminds you to back up the data periodically by prompting you to save the data in your preferred location. The *Primary Test Manager* data is backed up in DBPTM format.

To back up the data without the *Primary Test Manager* prompt:

1. In the home view, click **Back up your data**.

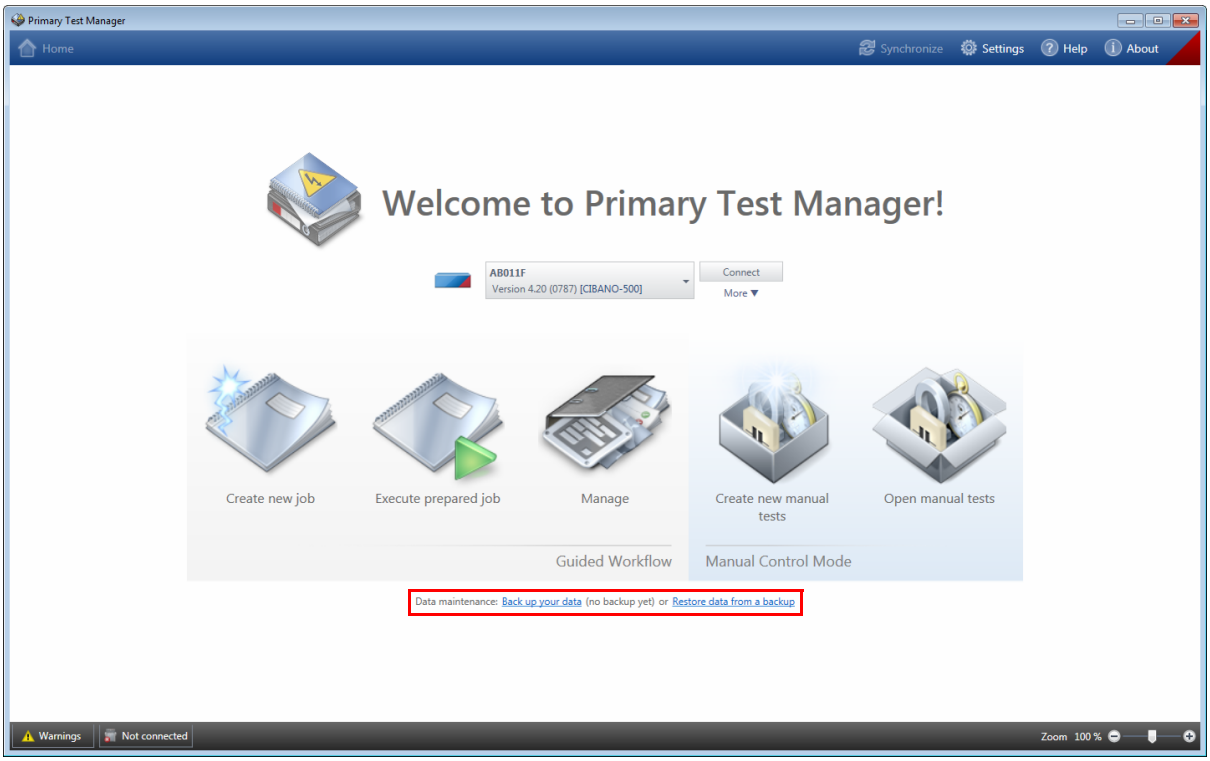


Figure 6-11: *Primary Test Manager* home view

2. Save the data in your preferred location.

To restore the data:

1. In the home view, click **Restore data from a backup**.
2. Browse to the file you want to restore.

6.4 Data synchronization

Primary Test Manager comes with the client/server architecture. With this feature, you can synchronize your local database with the *Primary Test Manager* server database.

Note: To synchronize your data, you need a license. To get the license, contact your regional OMICRON Service Center or sales partner. You can find our Service Center or sales partner closest to you at www.omicronenergy.com.

The data synchronization is a partial data replication based on subscriptions, that is, all local data is synchronized with the server database and selected data on the server is synchronized with the local database.

6.4.1 Server settings

Before synchronizing the *Primary Test Manager* databases for the first time, you need to set the server settings.

1. In the title bar, click **Settings**, and then select the **Databases** tab.
   The next step depends on the data synchronization method you use: *DataSync* via web server or *DataSync* on premises.

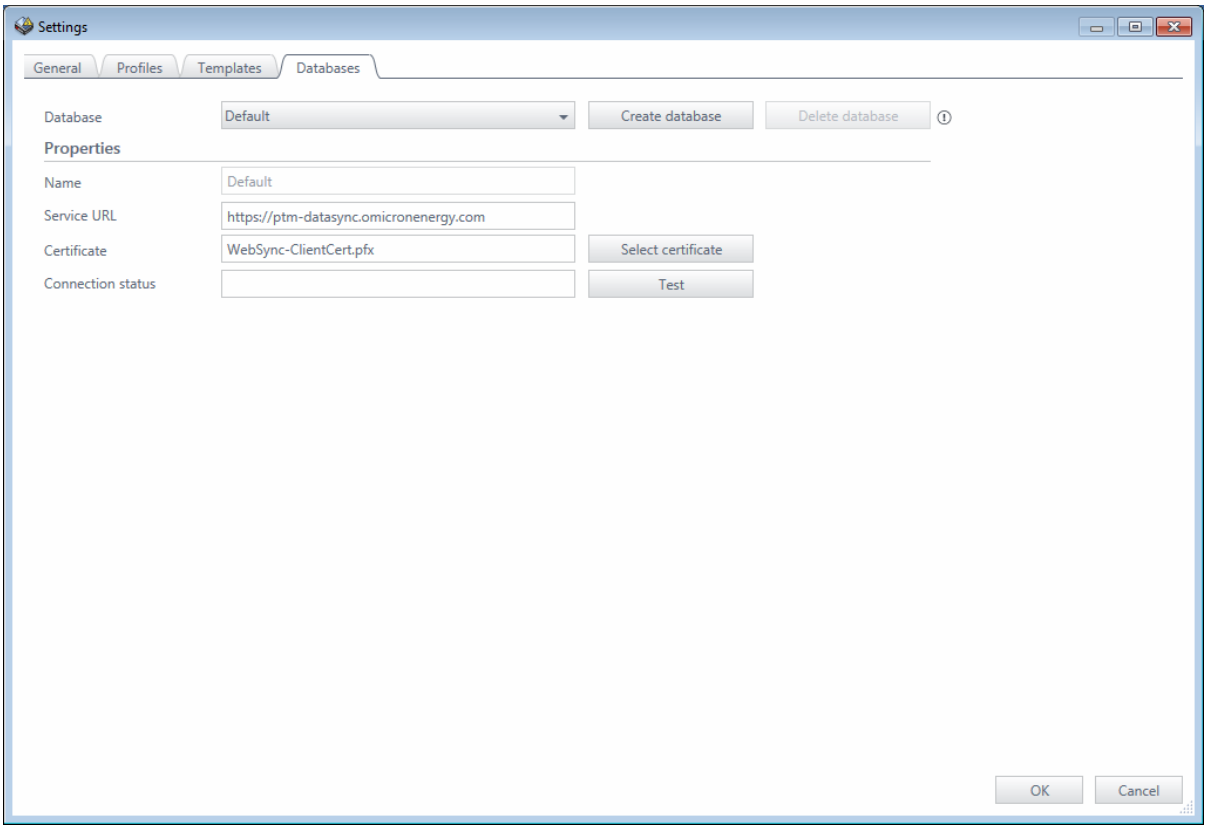


Figure 6-12: Server settings for *DataSync*

DataSync via web server

► For the service URL and certificate for *DataSync* via web server, contact your regional OMICRON Service Center.

DataSync on premises

► For the service URL and certificate for *DataSync* on premises, contact your system administrator.

2. On the **Databases** tab, enter the **Service URL** and upload the **Certificate**.
3. To test the connection to the server, click **Test** next to the **Connection status**.

6.4.2 Managing subscriptions

You can select data on the server which you want to synchronize with your local data by managing subscriptions. To manage subscriptions:

1. In the home view (see Figure 6-1: "Primary Test Manager home view" on page 31), click the **Manage** button .

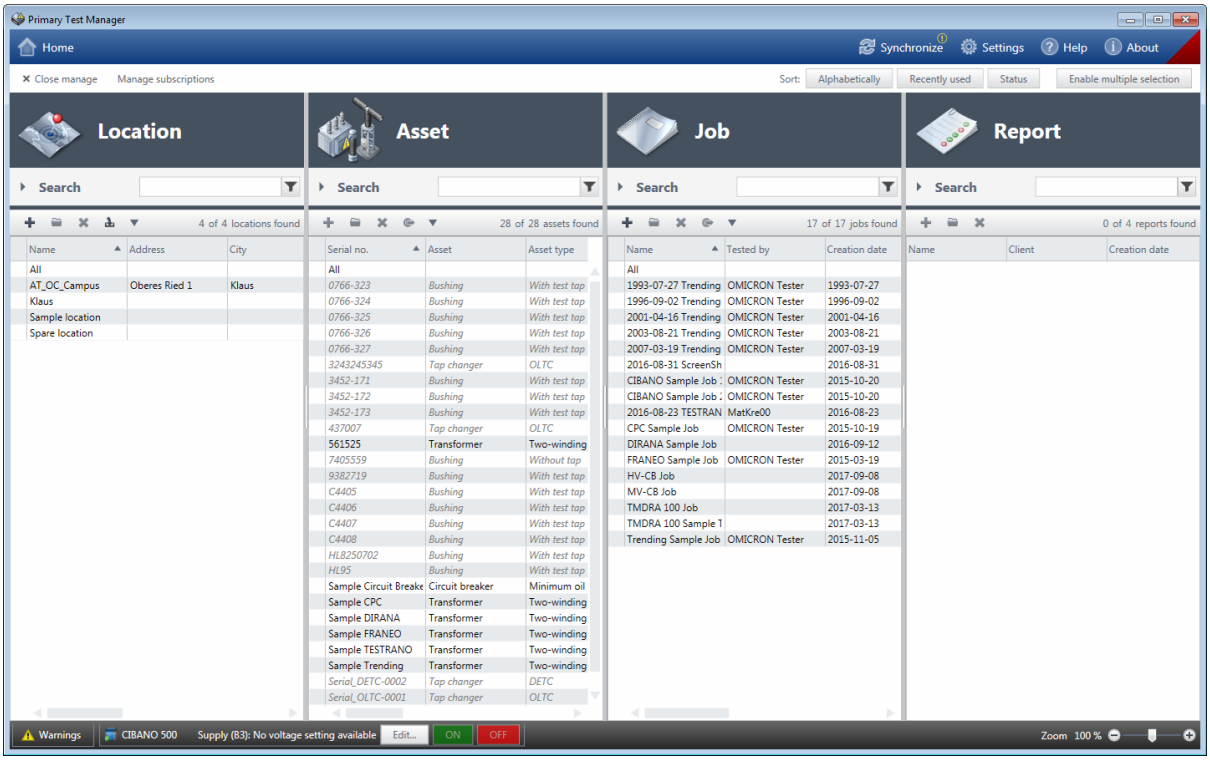


Figure 6-13: Manage view

2. In the manage view, click **Manage subscriptions** on the top of the workspace.
3. In the **Subscriptions** dialog box, select the data on the server you want to synchronize with your local data.

6.4.3 Database synchronization

► To synchronize the local *Primary Test Manager* database with the server database, click **Synchronize** in the title bar of the **Manage** view.
Primary Test Manager then displays the synchronization progress.

Note: You can synchronize databases at any time, as long as a connection to the server database is available.

When the database synchronization is complete, the locations, assets, and jobs (objects) newly added to the local database are marked with blue dots in the manage view. You can sort the objects by this column. As soon as you open an object, its blue dot is removed. All blue dots are removed when you perform another database synchronization.

7 Create new job

When creating a new job, *Primary Test Manager* leads you through the guided test workflow. To open the create new job view, click the **Create new job** button in the home view.

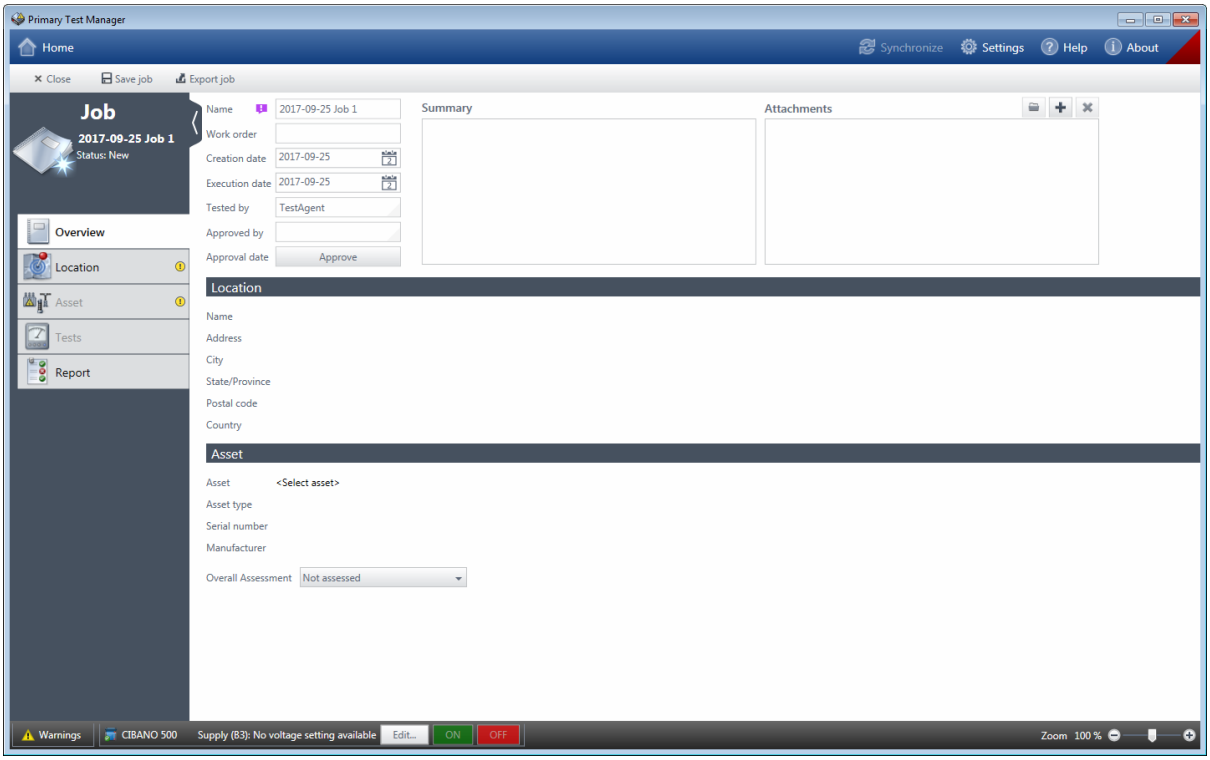


Figure 7-1: Create new job view

In the create new job view, you can configure and execute jobs. A job contains all relevant information about the location, the asset under test, and the tests. With *Primary Test Manager*, you can process jobs as separate entities. During the guided test workflow, the job status displayed in the left pane of the create new job view changes. The following table describes the job statuses.

Table 7-1: Job statuses

Status	Description
New	Location has been defined.
Prepared	Asset has been defined.
Partially executed	At least one measurement has been executed.
Executed	All tests of the job have been executed.
Approved	Job has been approved.

7.1 Guided test workflow

The guided test workflow leads you through the following steps:

1. Enter the job data (see 7.2 "Job overview" on page 48).
2. Specify the location (see 7.3 "Location view" on page 50).
3. Specify the asset (see 7.4 "Asset view" on page 54).
4. Specify and perform the tests (see 7.5 "Test view" on page 60).
5. Generate the test reports (see 14 "Generate test reports" on page 83).

To navigate through the test workflow, click the navigation buttons in the left pane of the create new job view.

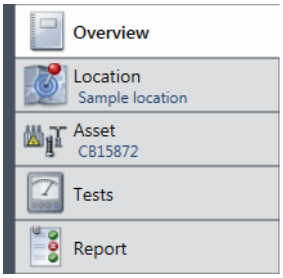


Figure 7-2: Navigation buttons

Note: You can anytime interrupt the test workflow and return to any view by clicking the corresponding navigation button.

By using the commands on the menu bar, you can process jobs. The following table describes the available operations.

Table 7-2: Operations on the jobs

Command	Action
Close	Closes a job displayed in the create new job view and leads you back to home or manage view respectively.
Save job	Saves the job displayed in the create new job view.
Copy test[1]	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Take screenshot[1]	Takes screenshot of the selected area of the *Primary Test Manager* workspace. The screenshot appears as attachment in the **General** area and can be attached to the test report (see 14 "Generate test reports" on page 83).

1 Only available if a test is open

For more information about operations on the jobs, see 9 "Manage objects" on page 66.

7.2 Job overview

In the job overview of the create new job view, you can enter the job data (see Table 7-3: "Job data" on page 48). In the course of the guided test workflow, *Primary Test Manager* sets also some basic location, asset, and test data. To open the job overview, click the **Create new job** button in the home view.

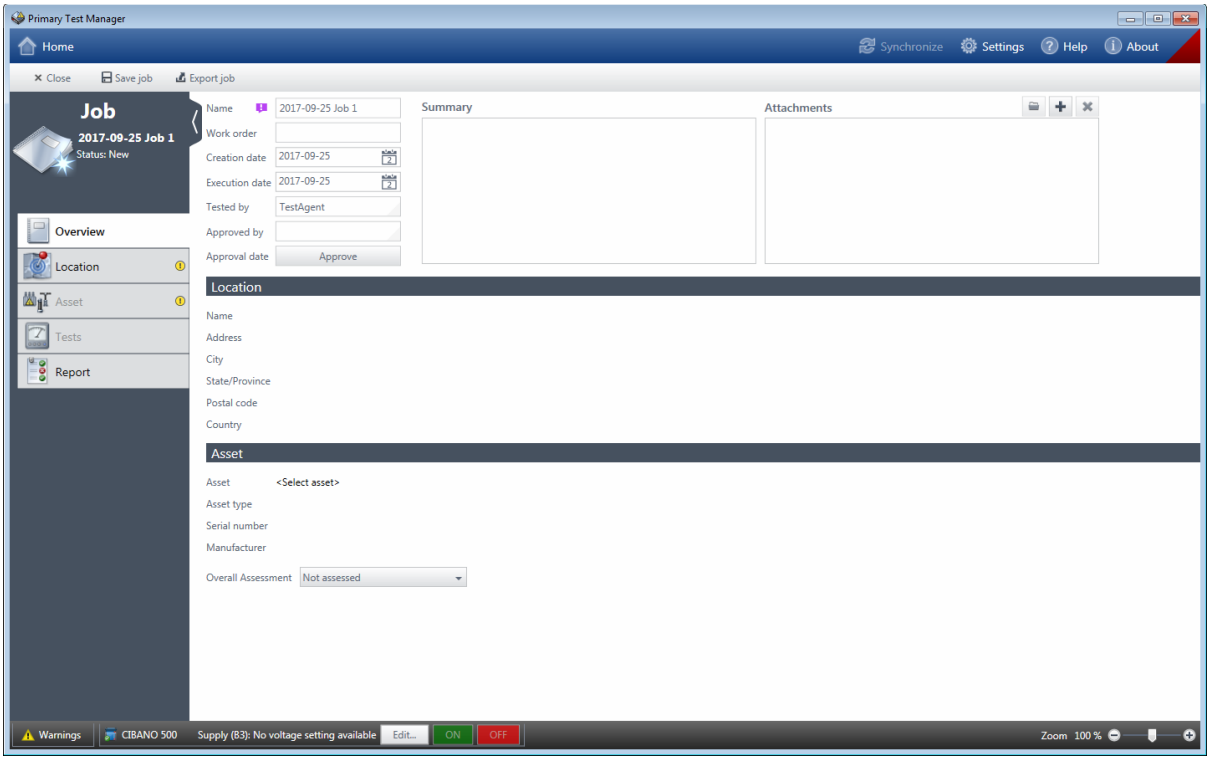


Figure 7-3: Job overview

7.2.1 Job data

The following table describes the job data.

Table 7-3: Job data

Data	Description
Name/WO[1]	Name of the job or work order (by default generated by *Primary Test Manager*)
Creation date	Date the job was created
Execution date	Date the job was executed
Tested by	Person who performed the test

Table 7-3: Job data (continued)

Data	Description
Approved by	Person who approved the test
Approval date	Date the job was approved (see 7.2.2 "Approving jobs" later in this section)
Summary	Text field to summarize the job data in own words.
Attachments	Attachments to the job (see 7.2.3 "Managing attachments" on page 49)

1 Mandatory data

7.2.2 Approving jobs

If the job displayed in the job overview has been approved, you can set the approval date of the job. To set the job approval date, click **Approve**.

Note: After approving a job, some settings cannot be edited anymore. The job approval cannot be undone.

7.2.3 Managing attachments

Under **Attachments**, you can manage attachments to jobs.

To add an attachment to a job:

1. Click the **Add** button ➕.
2. In the **Select Files** dialog box, browse to the file you want to attach to the job.

To open an attachment, do one of the following:

► Select the attachment, and then click the **Open** button 🗁.

► Double click the attachment.

To delete an attachment from a job:

1. Select the attachment you want to delete.
2. Click the **Remove** button ✖.

7.3 Location view

In the location view of the create new job view, you can specify locations. To open the location view, click the **Location** navigation button .

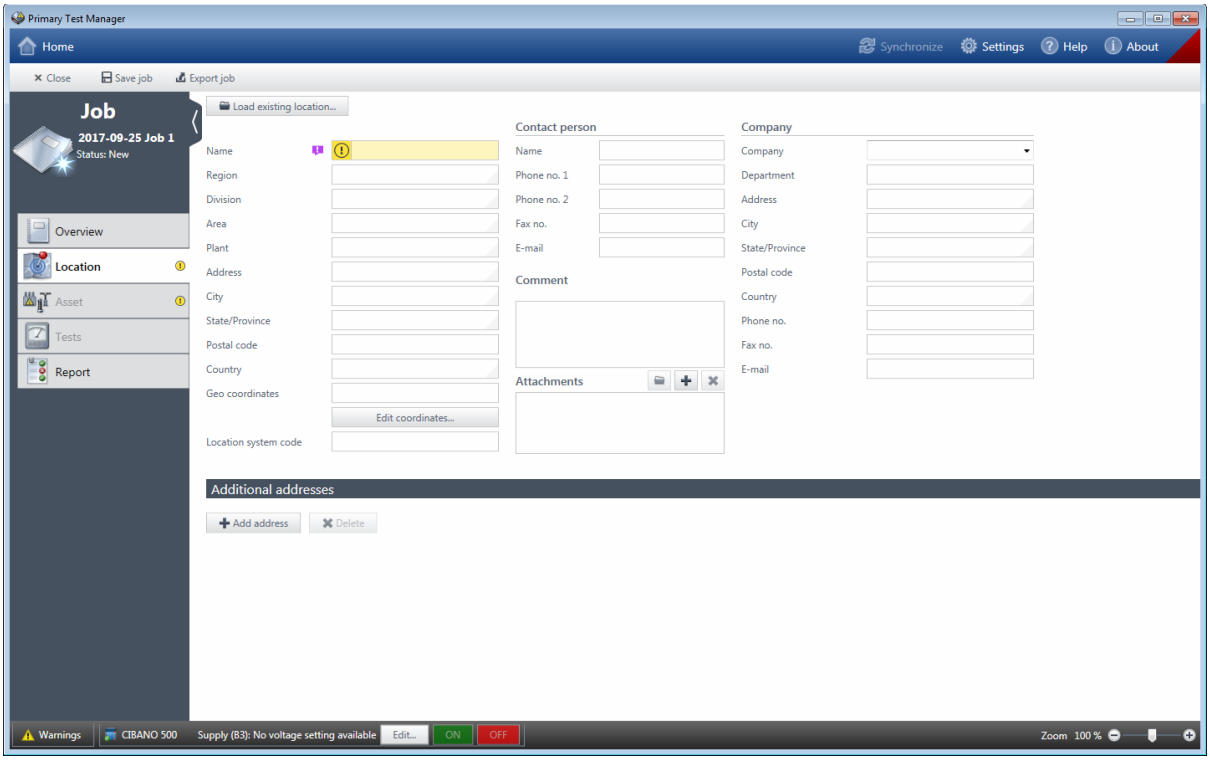


Figure 7-4: Location view

To specify a location, do one of the following:

► Enter the location data (see Table 7-4: "Location data" later in this section).

Note: If you enter location data different from the master location, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master location or update the master location. For more information, see 9.3 "Understanding the master locations and assets" on page 69.

► To load the location data available in *Primary Test Manager*, click **Load existing location**, and then select the location you want to load in the **Select location** dialog box.

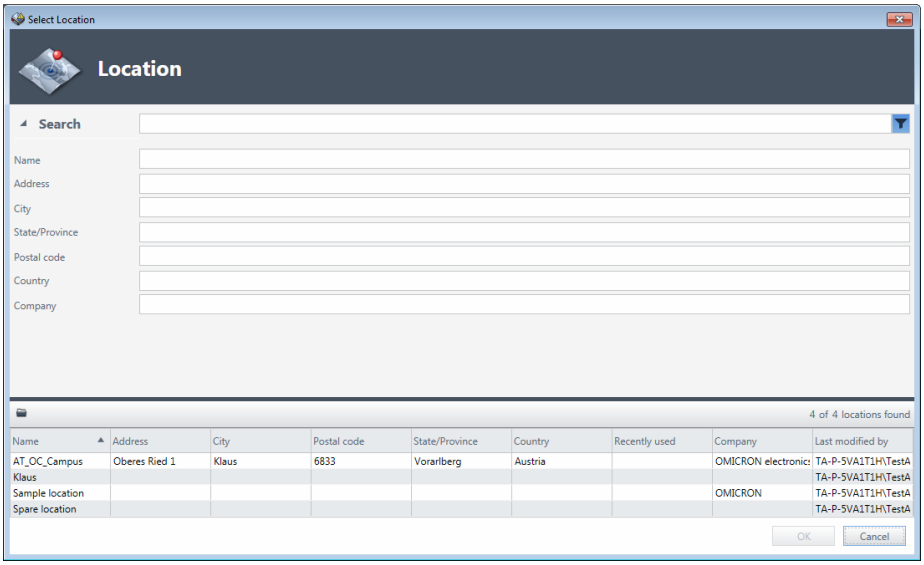


Figure 7-5: **Select location** dialog box

In the **Select location** dialog box, you can search for locations (see 9.1 "Search for objects" on page 67).

7.3.1 Location data

The following table describes the location data.

Table 7-4: Location data

Data	Description
Name[1]	Name of the location where the asset is located
Region	Region where the asset is located
Division	Division where the asset is located
Area	Area where the asset is located
Plant	Plant where the asset is located
Address	Address of the location where the asset is located
City	City where the asset is located
State/Province	State or province where the asset is located
Postal code	Postal code of the location where the asset is located
Country	Country where the asset is located
Geo coordinates	Geo coordinates of the location where the asset is located (see 7.3.2 "Setting the geo coordinates" later in this section)
Location system code	Location code used by maintenance planning systems

Table 7-4: Location data (continued)

Data	Description
Contact person	
Name	Name of the contact person
Phone no. 1	Phone number of the contact person
Phone no. 2	Alternative phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person
Comment	Comment on the location
Attachments	Attachments to the location (see 7.3.3 "Managing attachments" on page 53)
Company	
Company	Company the asset belongs to
Department	Department of the company
Address	Address of the company
City	City where the company is located
State/Province	State or province where the company is located
Postal code	Postal code of the company
Country	Country where the company is located
Phone no.	Phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person

1 Mandatory data

In the location view, you can enter additional addresses of, for example, a client, owner or utility. To enter additional addresses, click **Add address** under **Additional addresses**. For the additional address data, see Table 7-4: "Location data" on page 51.

7.3.2 Setting the geo coordinates

To set the geo coordinates of a location:

1. In the location view, click **Edit coordinates**.

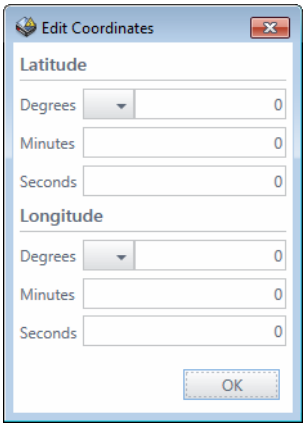


Figure 7-6: **Edit Coordinates** dialog box

2. In the **Edit Coordinates** dialog box, enter the latitude and longitude of the location.

7.3.3 Managing attachments

Under **Attachments**, you can manage attachments to locations.

To add an attachment to a location:

1. Click the **Add** button ➕.
2. In the **Select Files** dialog box, browse to the file you want to attach to the location.

To open an attachment, do one of the following:

► Select the attachment, and then click the **Open** button 🗀.

► Double click the attachment.

To delete an attachment from a location:

1. Select the attachment you want to delete.
2. Click the **Remove** button ✖.

7.4 Asset view

In the asset view of the create new job view, you can specify assets. To open the asset view, click the **Asset** navigation button .

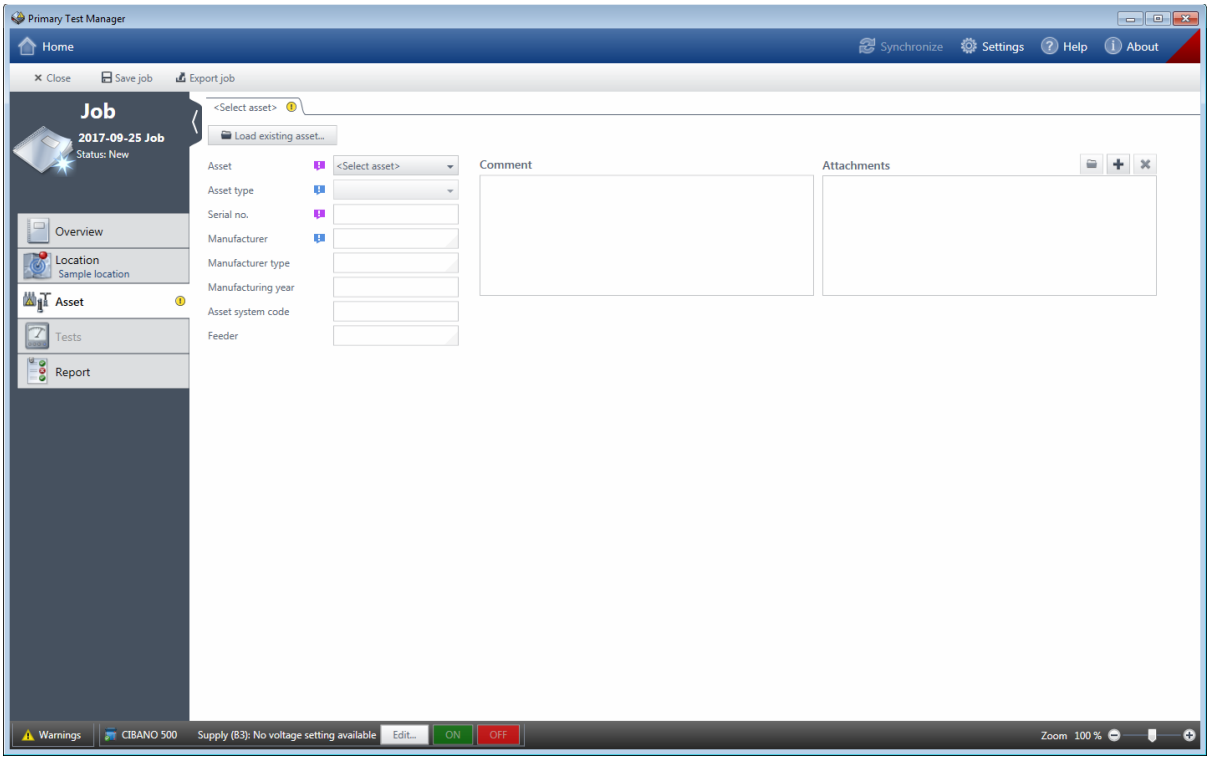


Figure 7-7: Asset view

The asset view depends on the asset you want to specify with *Primary Test Manager*. To specify an asset, do one of the following:

- ► Enter the asset data.The asset data includes the general asset data common to all assets (see Table 7-5: "General asset data" on page 55) and the asset-specific data described in 15 "Circuit breaker data" on page 85 and 16 "Spare bushing data" on page 100.

  Note: If you enter asset data different from the master asset, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master asset or update the master asset. For more information, see 9.3 "Understanding the master locations and assets" on page 69.
- ► To load the asset data available in *Primary Test Manager*, click **Load existing asset**, and then select the asset you want to load in the **Select asset** dialog box.

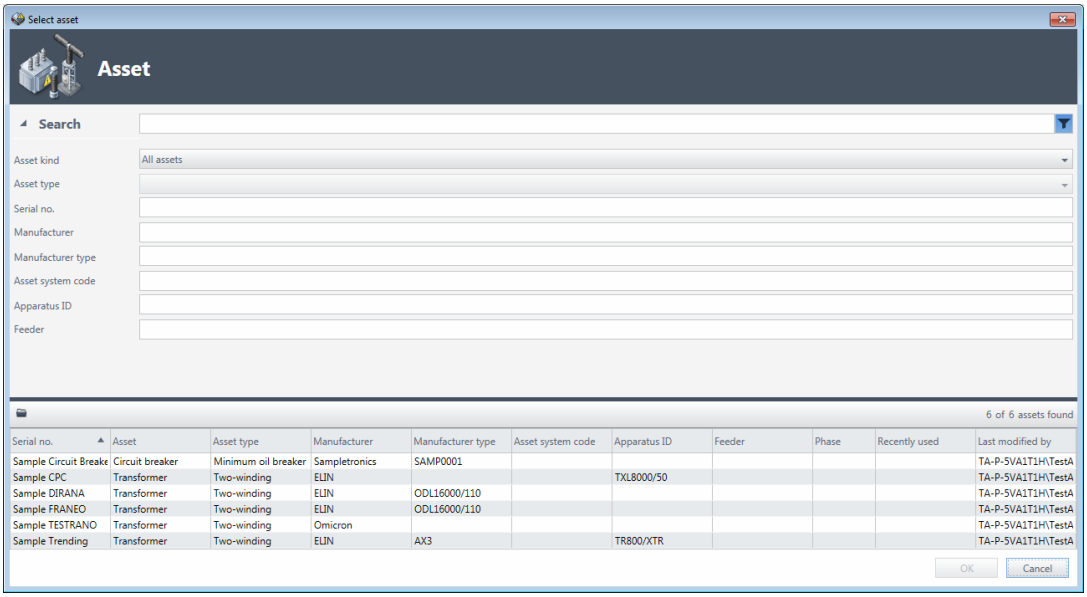


Figure 7-8: **Select asset** dialog box

In the **Select asset** dialog box, you can search for assets (see 9.1 "Search for objects" on page 67) and sort them alphabetically or in the chronological order.

7.4.1 General asset data

The following table describes the general asset data.

Table 7-5: General asset data

Data	Description
Asset[1]	Asset under test
Asset type	Type of the asset
Serial no.[1]	Serial number of the asset
Manufacturer	Manufacturer of the asset
Manufacturer type	Type of the asset according to the manufacturer
Manufacturing year	Year of the asset's manufacturing
Asset system code	Code of the asset used by the maintenance planning systems
Apparatus ID[2]	Identifier of the asset
Feeder	Feeder the asset is connected to
Comment	Comment on the asset
Attachments	Attachments to the asset (see 7.4.2 "Managing attachments" on page 56)

1 Mandatory data
2 Visible after you have selected an asset

7.4.2 Managing attachments

Under **Attachments**, you can manage attachments to assets.

To add an attachment to an asset:

1. Click the **Add** button ➕.
2. In the **Select Files** dialog box, browse to the file you want to attach to the asset.

To open an attachment, do one of the following:

► Select the attachment, and then click the **Open** button 🗁.

► Double click the attachment.

To delete an attachment from an asset:

1. Select the attachment you want to delete.
2. Click the **Remove** button ✖.

7.4.3 Circuit breaker view

In the circuit breaker view, you can specify circuit breakers and assets associated with the circuit breakers such as bushings.

To specify a circuit breaker:

1. From the **Asset** list, select **Circuit breaker**.
2. From the **Asset type** list, select the type of the circuit breaker.

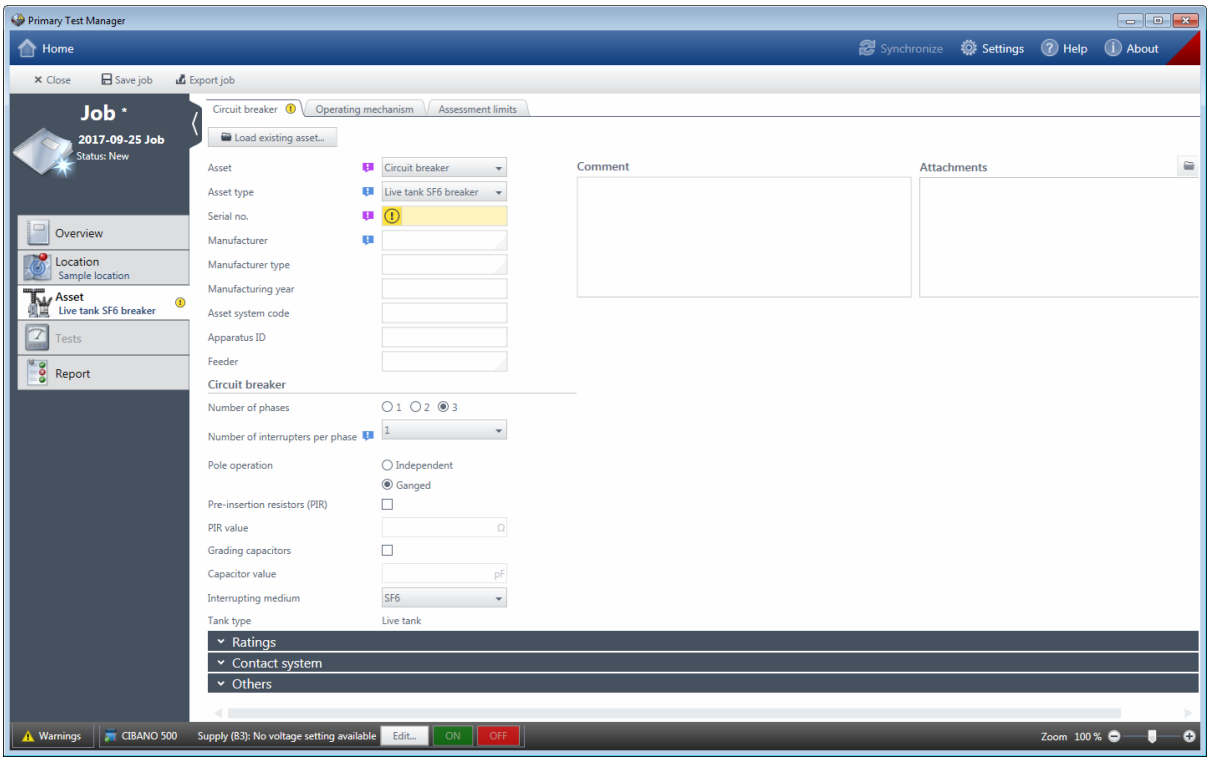


Figure 7-9: Circuit breaker view

3. In the circuit breaker view, enter further general asset data (see Table 7-5: "General asset data" on page 55).
4. In the **Circuit breaker** area, enter the circuit breaker data (see 15 "Circuit breaker data" on page 85).
5. Specify the operating mechanism of the circuit breaker (see "Operating mechanism tab" on page 57).
6. Optionally, specify the bushings mounted on the circuit breaker (see "Bushings tab" on page 58).
7. Set the assessment limits of the circuit breaker (see "Assessment limits tab" on page 59).

Operating mechanism tab

On the **Operating mechanism** tab, you can specify the circuit breaker's operating mechanism.

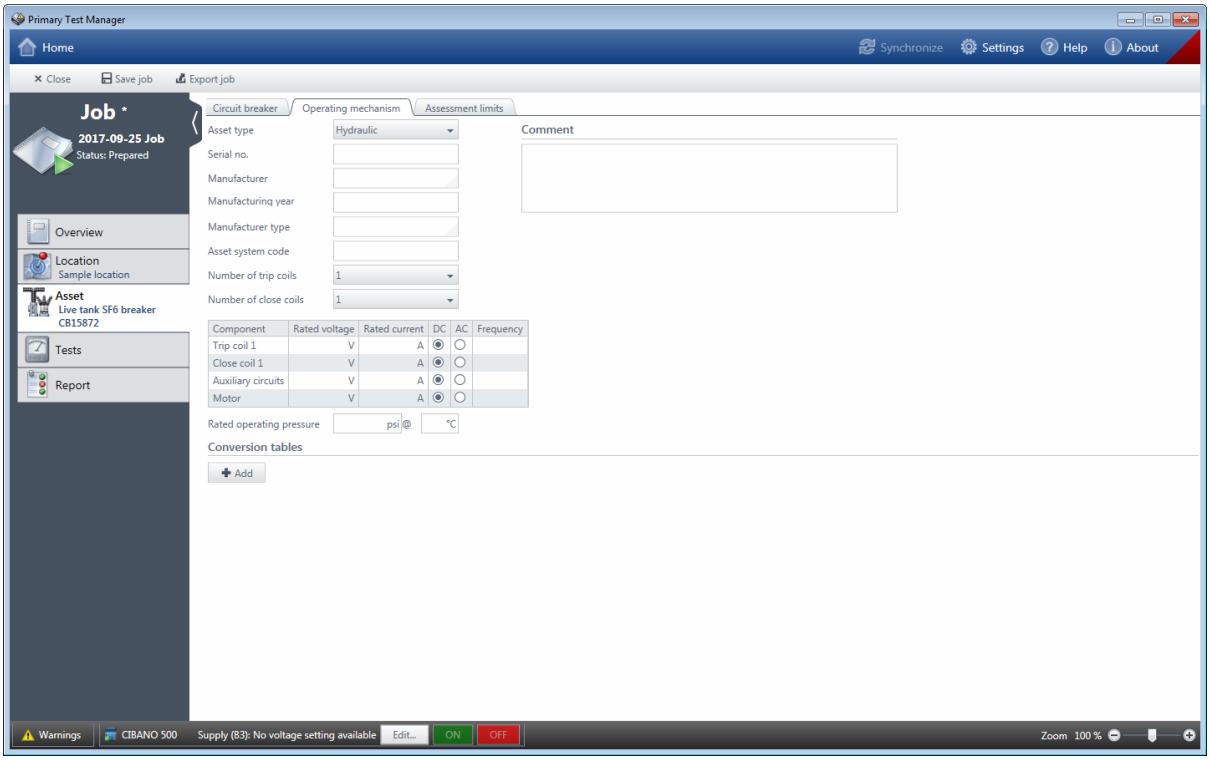


Figure 7-10: Circuit breaker view: **Operating mechanism** tab

To specify an operating mechanism, enter the operating mechanism data (see 15.1 "Operating mechanism data" on page 87).

Bushings tab

On the **Bushings** tab, you can specify bushings mounted on the circuit breaker.

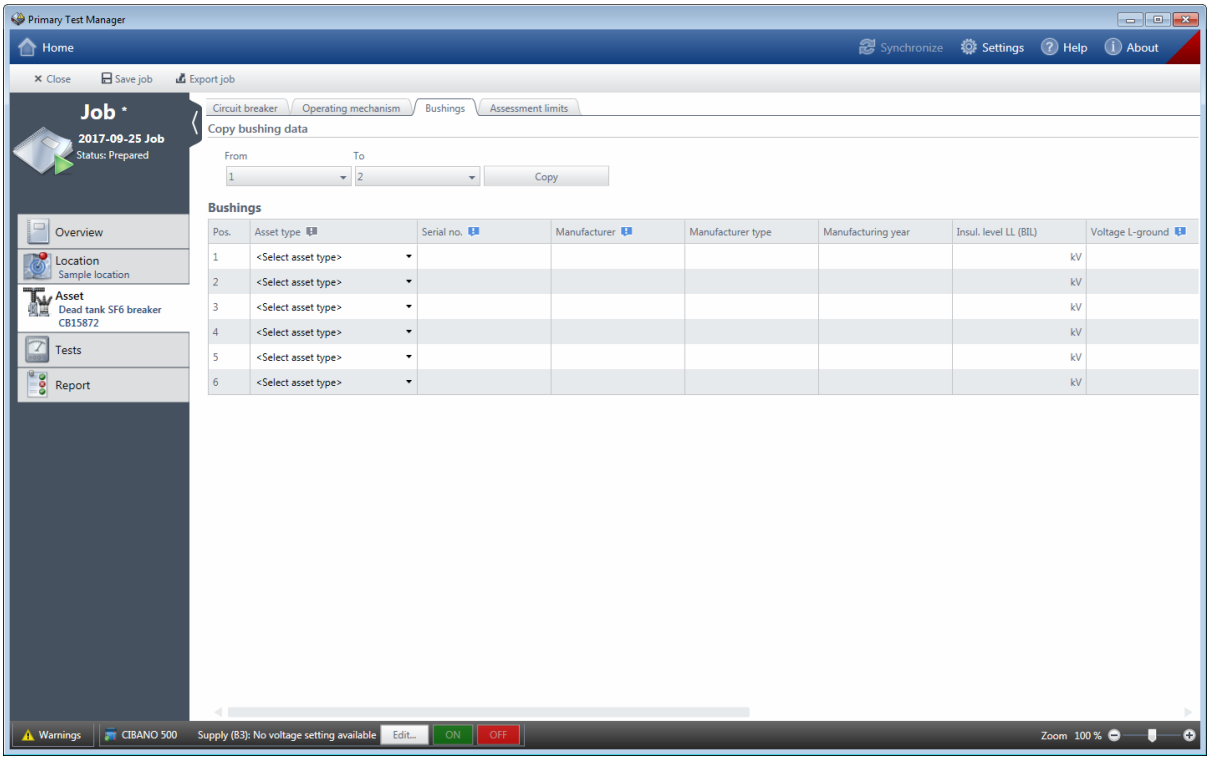


Figure 7-11: Circuit breaker view: **Bushings** tab

To specify a bushing:

1. From the **Asset type** list, select the type of the bushing for all circuit breaker's terminals.
2. Enter the bushing data (see 16 "Spare bushing data" on page 100).

Under **Copy bushing data**, you can copy data of a bushing to other bushings. To copy the bushing data, select the respective bushings from the **From** and **To** lists, and then click **Copy**.

Assessment limits tab

On the **Assessment limits** tab, you can set the circuit breaker's absolute and relative assessment limits.

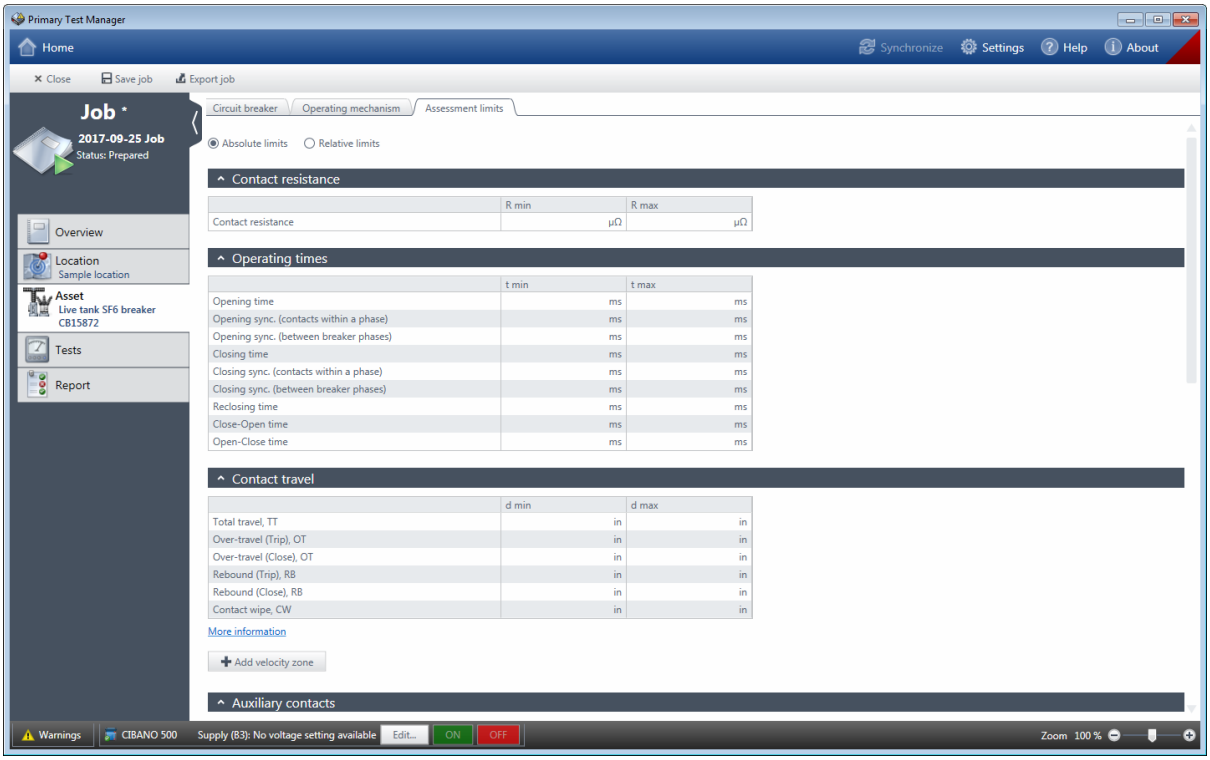


Figure 7-12: Circuit breaker view: **Assessment limits** tab

To set the circuit breaker's assessment limits:

1. On the **Assessment limits** tab, click **Absolute limits** or **Relative limits**.
2. Enter the assessment limits (see 15.3 "Assessment limits" on page 91).

7.5 Test view

In the test view, you can select, import and perform tests. To open the test view, click the **Tests** navigation button .

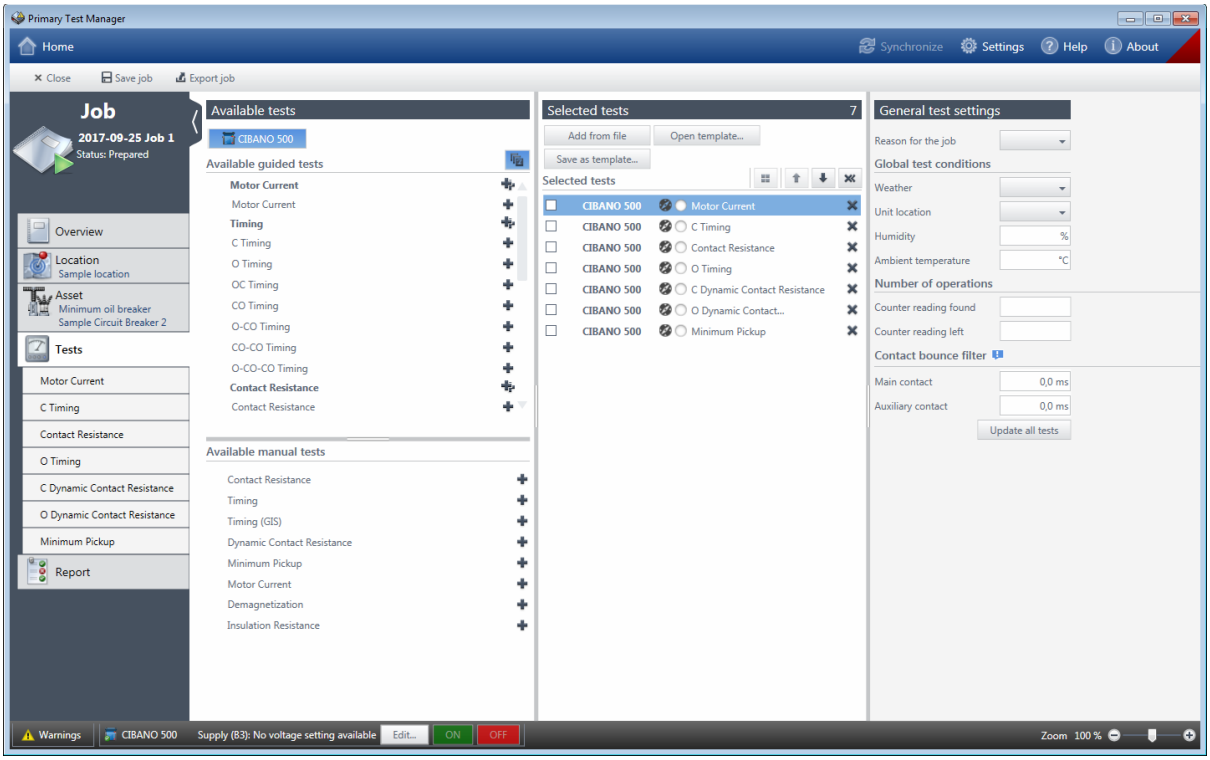


Figure 7-13: Test view

The test view is divided into the **Available tests** area, the **Selected tests** area, and the **General test settings** area.

On the top of the **Available tests** area, click the button labeled with the test system with which you want to perform the test. Then *Primary Test Manager* displays the available guided tests and optional manual tests supported for the selected test system and the asset under test. To display the guided tests grouped in categories, click the **Show test categories** button .

You can select tests for different test systems supported by *Primary Test Manager* within the same job. Then the symbol indicates the tests not available for the connected test system to signal to you that you need to connect another test system before proceeding to execute the job.

The optional manual tests are asset-independent. You can perform manual tests for any asset described in this User Manual, but *Primary Test Manager* does not guide you through the tests and provides no test settings data. The manual tests offer a large amount of flexibility to define the test procedures and specify test settings according to your specific needs. For more information about the manual tests, see 10 "Create new manual tests" on page 73.

The **Selected tests** area displays the tests and test groups you want to perform. By default, *Primary Test Manager* displays the tests recommended by OMICRON.

7.5.1 Selecting tests

► To add a test into the **Selected tests** area, click the ✚ symbol next to the test name or double-click the test in the **Available tests** area.

► To add all tests of a category into the **Selected tests** area, click the ✚ symbol.

Note: The tests added to the **Selected tests** area are displayed under **Tests** in the left pane of the test view.

► To rename a test, click the test name, and then type the name you want to use.

The **Selected tests** area displays the test in the recommended execution order. You can change the order of the tests by dragging them or by using the ↑ and ↓ symbols.

► To remove a test from the **Selected tests** area and from the left pane, click the ✖ symbol next to the test name.

► To open a test, click the test name in the left pane of the test view.

After you have opened a test, the workspace is split into the following areas:

- **General**
  Here you can type a comment on the test and add an attachment.
- **Hardware configuration**
  Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Application" on page 102.
- **Settings and conditions**
  Displays the test settings. For the test settings description, see 17 "Application" on page 102.
- **Assessment**
  Provides access to setting the assessment limits. For the assessment limit description, see 15.3 "Assessment limits" on page 91.
- **Measurements**
  Displays the measurement results. For more information, see 13 "Display measurement results" on page 80.

7.5.2 Grouping tests

With *Primary Test Manager*, you can group tests. You define the hardware configuration and certain settings and conditions for a test group. These settings are then applied to all tests in the test group.

To group tests:

1. In the **Selected tests** area, select the check boxes next to the tests you want to group.
2. Click the ▦ symbol.

Note: The test groups are displayed under **Tests** in the left pane of the test view.

► To rename the test group, click the test group name, and then type the name you want to use.

► To remove a test from the test group, click the the ▦ symbol next to the test name.

► To remove a test group from the **Selected tests** area and from the left pane, click the ✖ symbol next to the test group name.

► To open a test group, click the test group name in the left pane of the test view.

After you have opened a test group, the workspace is split into the following areas:

- **Hardware configuration**
  Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Application" on page 102.
- **Settings and conditions**
  Displays the test settings common to all tests of the test group. For information on the test settings, see 17 "Application" on page 102.
- **Test control**
  Displays the test control buttons and the list of the tests with the execution and assessment status. For information on executing test groups, see 17.2.4 "Test group execution" on page 145.

7.5.3 General test settings

The **General test settings** area displays the following data.

Table 7-6: General test settings

Data	Description
Reason for the job	Reason why the job has been created
Global test conditions	
Weather	Weather conditions on site
Unit location	Location of the unit under test
Humidity	Relative ambient humidity on site
Ambient temperature	Ambient temperature on site
Number of operations	
Counter reading found	Counter reading before starting the tests
Counter reading left	Counter reading after the tests has finished
Contact bounce filter	
Main contact	Threshold value of the time interval between two consequent bounces of the main contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consequent bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Update all tests	Click **Update all tests** to set the contact bounce filter for all tests.

7.5.4 Importing tests

In the test view, you can import test data (measurement results without any information about the job, the asset or the location) in PTMA format.

To import test data:

1. In the **Selected tests** area, click **Add from file**.
2. In the **Open** dialog box, browse to the file you want the import.
   The tests contained in the imported PTMA file are appended to the test list.

For information about importing and exporting jobs, see 9.6 "Import and export jobs" on page 71.

7.5.5 Performing tests

To perform and assess the tests, you must know and understand the test settings and the measurement data. For detailed information, see 17 "Application" on page 102.

7.5.6 Processing templates

In the guided test workflow, you can save jobs as templates and open the saved templates. By using the templates, you can configure jobs according to your needs (for example, for repeated routines), and then repeatedly perform the (once defined) tests. When you create a new job, the favorite template for the corresponding manufacturer and manufacturer type is loaded automatically, if available.

To save a job as template:

1. In the guided test workflow, configure a job.
2. In the **Selected tests** area of the test view, click **Save as template**.

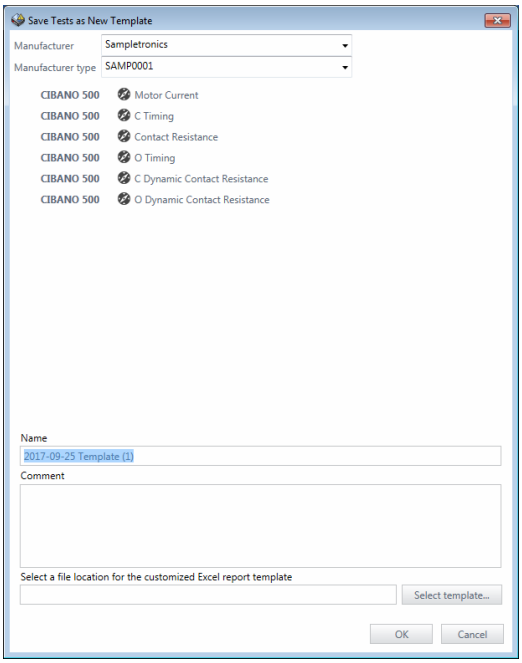


Figure 7-14: **Save Tests as New Template** dialog box

3. In the **Save Tests as New Template** dialog box:
   ► In the **Manufacturer** box, enter the manufacturer.
   ► In the **Manufacturer type** box, enter the manufacturer type.

   Note: Select **[Generic]** if you want to use the template for all circuit breakers of the same manufacturer or for all circuit breakers.

   ► In the **Name** box, type the template name.
4. Optionally, you can add a customized Microsoft Excel report template (see 14 "Generate test reports" on page 83) to the job template. To add a Microsoft Excel report template:
   ► Click **Select template**.
   ► In the **Select** dialog box, browse to the report template you want to add.

To open a template:

1. In the **Selected tests** area of the test view, click **Open template**.

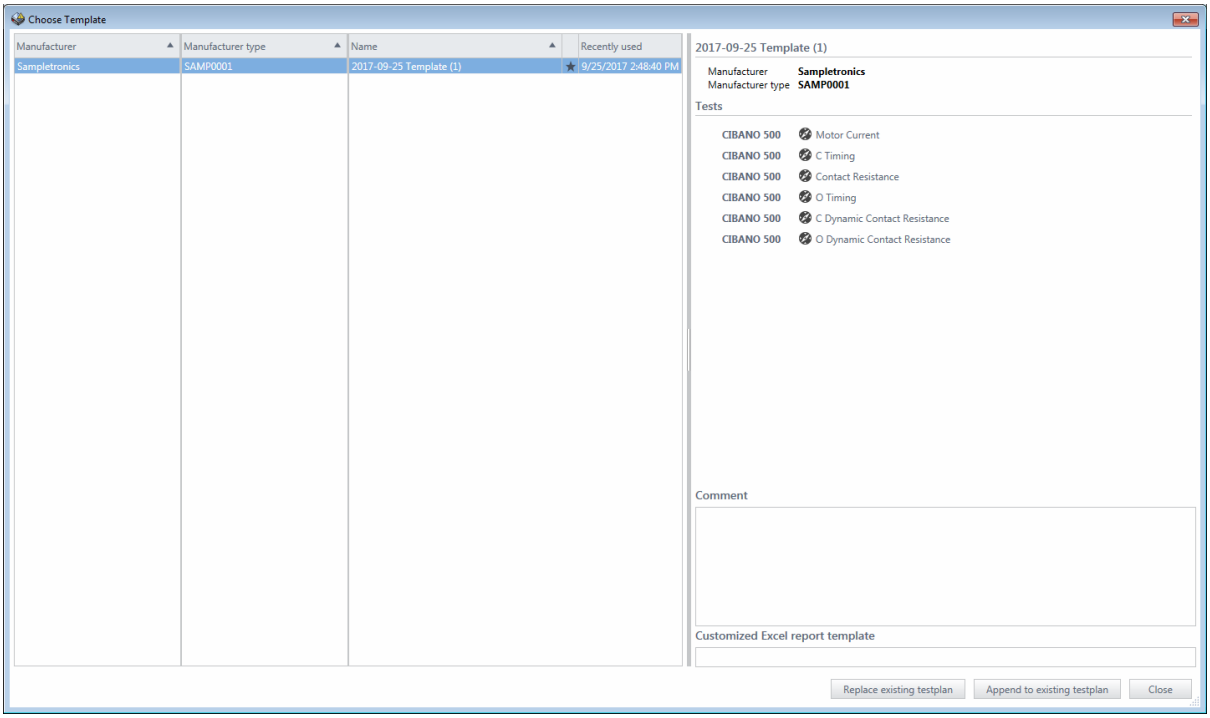


Figure 7-15: **Choose Template** dialog box

2. In the **Choose Template** dialog box, select the manufacturer, the manufacturer type and the template you want to open.

   Note: If you added a Microsoft Excel report template to the job template, its location is displayed under **Customized Excel report template**.

► To replace the tests in the currently opened job with the selected template, click **Replace existing testplan**.

► To add the selected template to the currently opened job, click **Append to existing testplan**.

Note: If you click **Append to existing testplan**, the Microsoft Excel report template will not be added to the currently opened job.

8 Execute prepared job

In a typical application scenario, *Primary Test Manager* tests primary assets in the field. To facilitate the field tests, you or your colleague can configure a job in the office, save it in *Primary Test Manager*, and execute it later in the field.

To execute a prepared job saved in a file:

1. In the home view, click the **Execute prepared job** button .

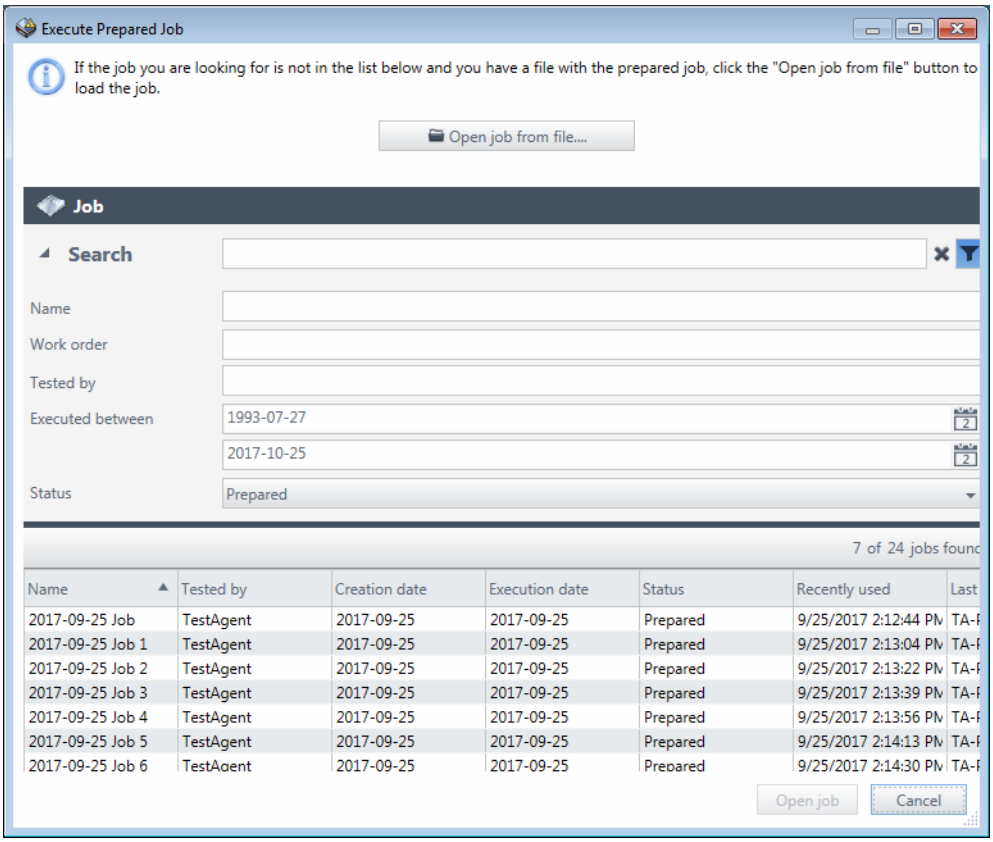


Figure 8-1: Execute prepared job view

2. In the execute prepared job view, click **Open job from file**.
3. In the **Open** dialog box, browse to the .ptm file you want to import.
4. Import the job, and then go through the guided test workflow (see 7 "Create new job" on page 46).

To execute a prepared job available in *Primary Test Manager*:

1. In the home view, click the **Execute prepared job** button .
2. In the execute prepared job view, search for the job you want to execute (see 9.1 "Search for objects" on page 67).
3. Open the job, and then go through the guided test workflow (see 7 "Create new job" on page 46).

9 Manage objects

In the manage view, you can manage locations, assets, jobs, and test reports. To open the manage view, click the **Manage** button in the home view.

Note: In this chapter, the locations, assets, jobs, and test reports are collectively called objects.

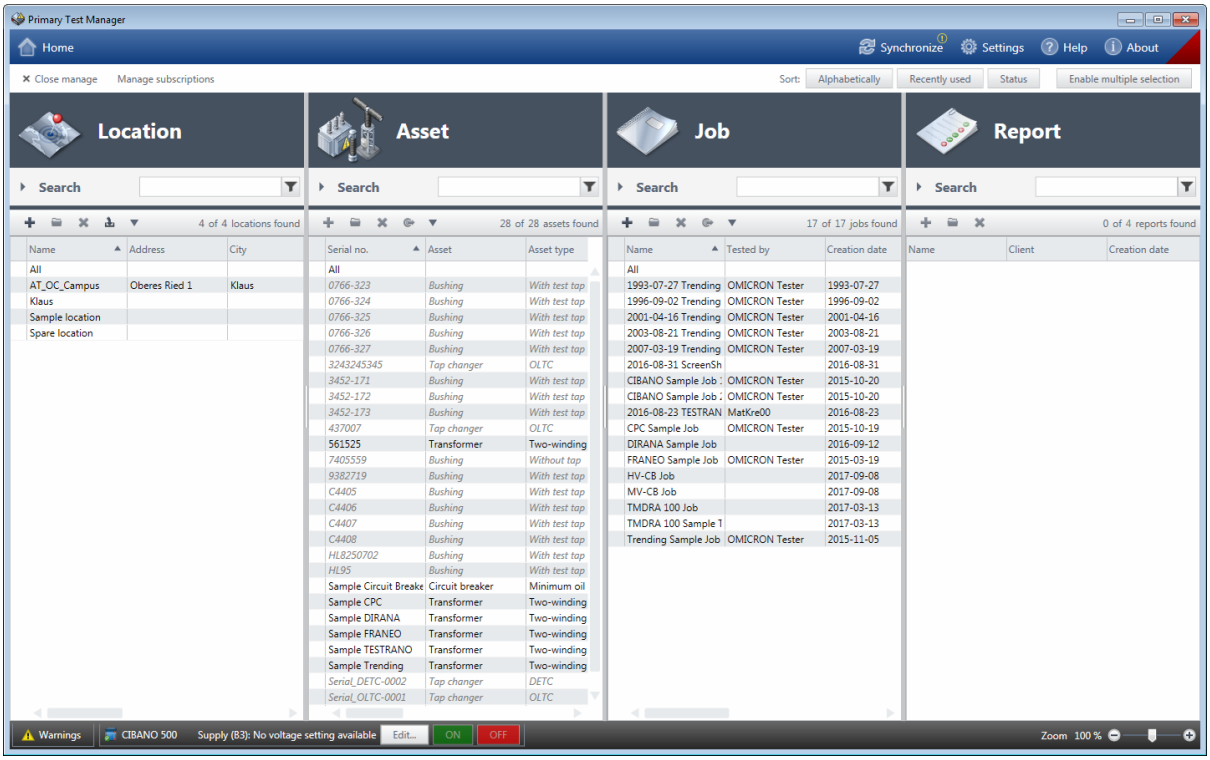


Figure 9-1: Manage view

Note: The mounted assets are displayed in italics. To hide them, expand the **Search** area under **Asset**, and then select the **Hide mounted assets** check box.

The manage view displays the objects in a hierarchical structure as follows:

- If you select a location, the manage view displays the assets, jobs, and reports associated with the selected location.
- If you select an asset, the manage view displays the jobs and reports associated with the selected asset.
- If you select a job, the manage view displays the reports associated with the selected job.

► To sort the objects alphabetically, click **Alphabetically** in the menu bar.

► To sort the objects in the chronological order, click **Recently used** in the menu bar.

► To rearrange the columns, drag and drop the column headers.

In the manage view, you can:

- Search for objects (see 9.1 "Search for objects" on page 67)
- Perform operations on objects (see 9.2 "Perform operations on objects" on page 68)
- Relocate assets (see 9.5 "Relocate assets" on page 70)
- Import and export jobs (see 9.6 "Import and export jobs" on page 71)

9.1 Search for objects

In the manage view, you can search for the objects available in *Primary Test Manager*:

- By searching for keywords in all object data
- By searching for keywords in particular object data

To search for keywords in all object data, type the keyword you search for in the respective **Search** box.

To search for keywords in particular object data:

1. Expand the **Search** area by clicking the arrow next to **Search**.
2. Type the keyword(s) you search for in the respective object data box(es).

The following table describes the location search data.

Table 9-1: Location search data

Data	Description
Name	Name of the location
Address	Address of the location
City	City where the asset is located
State/Province	State or province where the asset is located
Postal code	Postal code of the location
Country	Country where the asset is located
Company	Company the asset belongs to

The following table describes the asset search data.

Table 9-2: Asset search data

Data	Description
Asset kind	Asset under test
Asset type	Type of the asset
Serial no.	Serial number of the asset
Manufacturer	Manufacturer of the asset
Manufacturer type	Type of the asset according to the manufacturer
Asset system code	Code of the asset used by the maintenance planning systems
Apparatus ID	Identifier of the asset
Feeder	Feeder the asset is connected to

The following table describes the job search data.

Table 9-3: Job search data

Data	Description
Name/WO	Name of the job or work order
Tested by	Person who performed the test
Executed between	Time period between the job was executed
Status	Status of the job

The following table describes the report search data.

Table 9-4: Report search data

Data	Description
Name	Name of the report
Client	Customer for which the report is designated
Created between	Time period between the report was created

9.2 Perform operations on objects

To perform operations on objects, select an object from the respective list, and then do one of the following:

► Click the **Create new *object*** button ➕ to add a new object of the same category.

► Click the **Open selected *object*** button 🗀 to display the data of the selected object.

► Click the **Delete selected *object*** button ✖ to delete the selected object.

Additionally, you can copy jobs with the associated location, asset and test data. The test results and reports are not copied. To copy a job:

1. Select the job you want to copy.
2. Click the **Copy selected job** button 🗐.

To perform operations on multiple objects, click **Enable multiple selection** in the menu bar, and then do one of the following:

► To delete multiple locations, assets, jobs, and test reports, select the check boxes next to the objects you want to delete, and then click the **Delete selected *object(s)*** button ✖.

► To export multiple jobs, select the check boxes next to the jobs you want to export, and then click the **Export** button 🡕.

9.3 Understanding the master locations and assets

Primary Test Manager supports master locations and assets to help you keep your data consistent. When you create a job, the location and asset associated with the job – called master location and master asset respectively – are copied to the job.

Consequently, whenever you try to change the location or the asset of an existing job, a notification bar at the top of the *Primary Test Manager* workspace prompts you to do one of the following:

- ► Click **Import from master location** or **Import from master asset** to import the location or asset originally associated with the job (master location/asset) to the current job.
- ► Click **Update master location** or **Update master asset** to update the location or asset originally associated with the job (master location/asset) with the data of the current job.

9.4 Duplicate assets

In the manage view, you can duplicate assets available in *Primary Test Manager*. To duplicate an asset:

1. From the asset list, select the asset you want to duplicate.
2. Click the **Duplicate** button .
3. In the asset view, type the serial number(s) of the new asset.

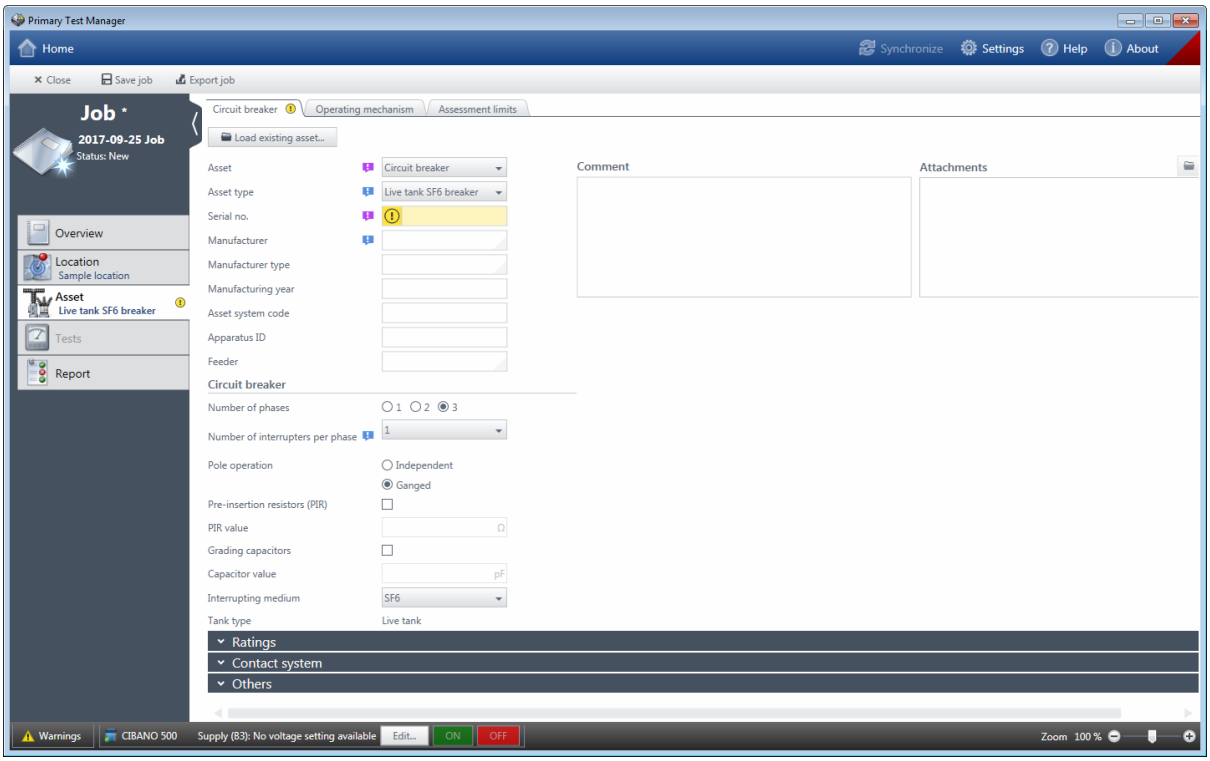


Figure 9-2: Asset view

4. In the asset view, click **Save asset**.

Note: By default, the duplicated asset are linked to location of the original asset. For relocating the asset to a different location, see 9.5 "Relocate assets" later in this chapter.

9.5 Relocate assets

In the manage view, you can relocate assets available in *Primary Test Manager*. To relocate an asset:

1. From the asset list, select the asset you want to relocate.
2. Click the **Relocate** button .

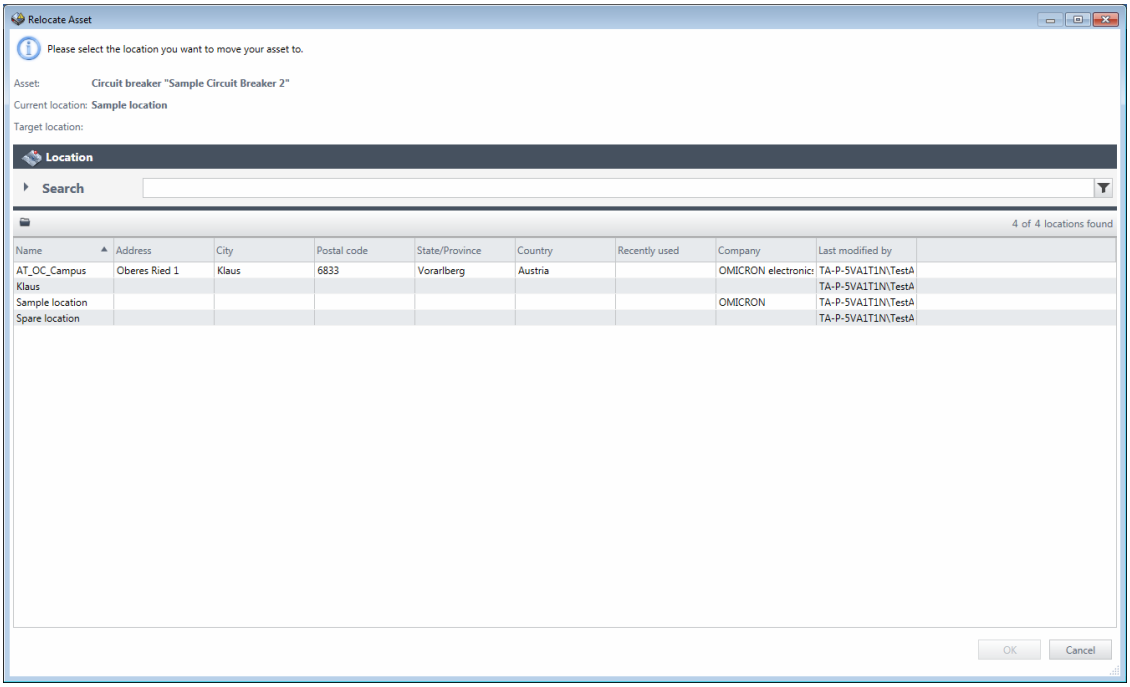


Figure 9-3: **Relocate Asset** dialog box

3. In the **Relocate Asset** dialog box, select the location you want to move the asset to.
4. If the asset you want to relocate is mountable, select an asset where the moved asset is to be mounted.

Note: You can filter the locations and assets by searching for keywords (see 9.1 "Search for objects" on page 67).

9.6 Import and export jobs

Primary Test Manager supports data exchange between different test systems.

You can export jobs in the *Primary Test Manager* native PTM format and as Microsoft Excel documents. To export a job:

1. From the job list, select the job you want to export.
2. Click the **Export** button .
3. In the **Save As** dialog box, browse to the folder where you want to save the file.

You can import *Primary Test Manager* jobs from file and from data stored with the Megger *CABAWin* software.

To import jobs from file:

1. In the **Job** area, click the **Import** button , and then click **Import from file**.
2. In the **Open** dialog box, select the data format of the files you want to import.
3. Browse to the folder with the files you want to import.
4. Select the files, and then click **Open**.

Primary Test Manager supports the following formats for import from file.

Table 9-5: Supported formats for import from file

File name extension	Description
.ptm	*Primary Test Manager* native exchange format
.ptma	Format for import of manual test data.[1]

1. To import manual test data, you must select the corresponding asset in the manage view.

To import a job from data stored with the Megger *CABAWin* software:

1. In the **Job** area, click the **Import** button , and then click **Import from CABAWin**.

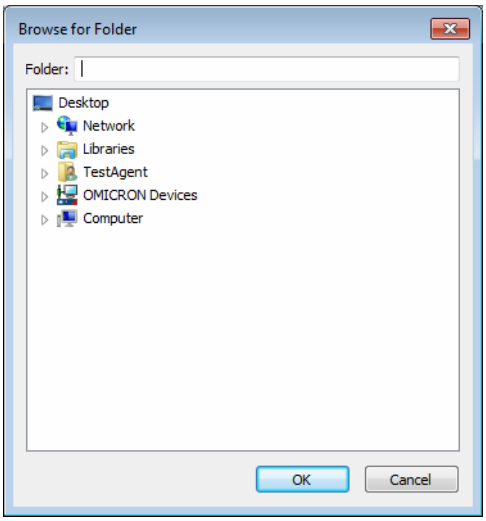


Figure 9-4: **Browse For Folder** dialog box

2. In the **Browse For Folder** dialog box, browse to the directory where your Megger *CABAWin* data is stored, for example, C:\Program Files (x86)\Programma\CABAWIN\Spec.
3. Select the folder one level above the plan and test folders, and then click **OK**.

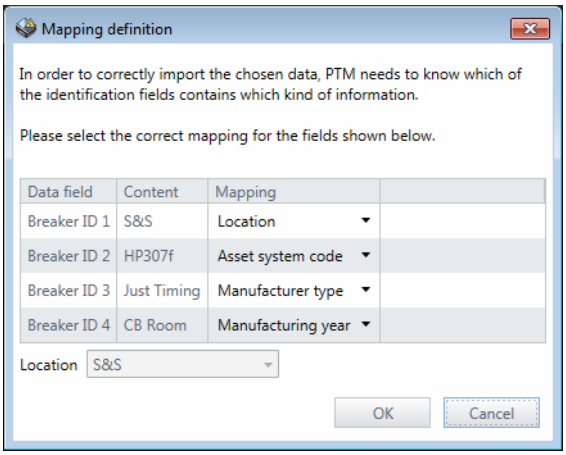


Figure 9-5: **Mapping definition** dialog box

4. In the **Mapping definition** dialog box, map the data fields to the location name and general asset data, if applicable.
5. If you have not mapped any data field to the location name, you can enter a location name in the **Location** box.
6. Click **OK** to confirm the mapping. If you entered a location name in the **Location** box, *Primary Test Manager* will create a new location with the entered name.

10 Create new manual tests

Primary Test Manager assists you to create new manual tests. To open the create new manual tests view, click the **Create new manual tests** button in the home view.

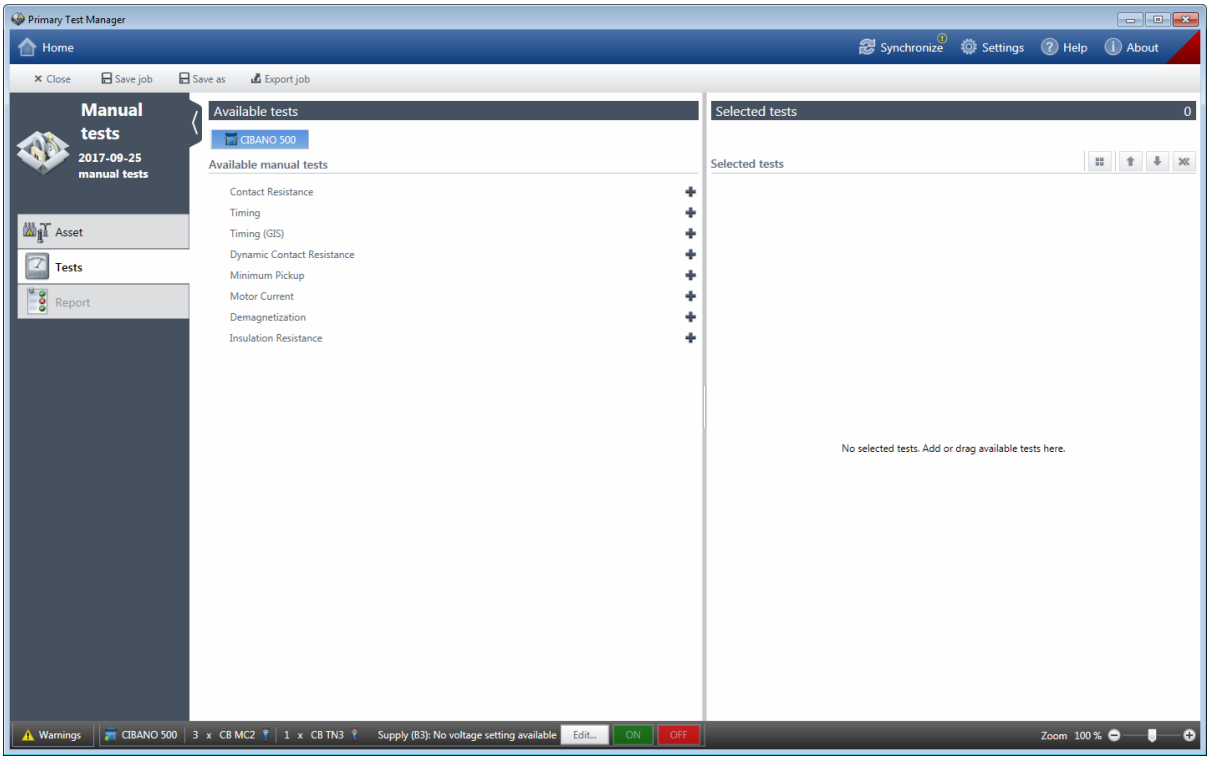


Figure 10-1: Create new manual tests view

The workspace of the create new manual tests view depends on the selected button in the left pane (see Figure 10-2: "Left-pane buttons" on page 74):

- Initially, the workspace is divided into the **Available tests** area and the **Selected tests** area. In this workspace, you can add tests to a job (see 10.1 "Add tests to a job" on page 74).
- If you click the **Asset** button, *Primary Test Manager* displays the general asset data (see 7.4.1 "General asset data" on page 55).
- If you click the **Report** button, *Primary Test Manager* displays the report view (see 14 "Generate test reports" on page 83). In the report view, you can configure and generate test reports.

10.1 Add tests to a job

► On the top of the **Available tests** area, click the button labeled with the test system with which you want to perform the test.

Then *Primary Test Manager* displays all available manual tests supported for the selected test system.

► To add a test to a job, click the ✚ symbol next to the test name or double-click the test in the **Available tests** area.

The tests added to a job are displayed in the **Selected tests** area and a button with the test name appears in the left pane.

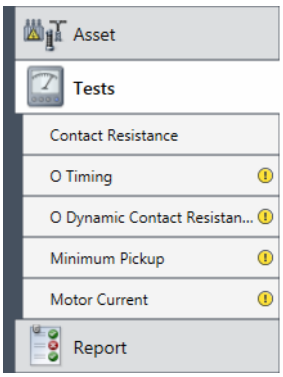


Figure 10-2: Left-pane buttons

Note: You can change the default test names. To rename a test, click the corresponding button in the left pane, and then click the test name.

► To remove a test from the **Selected tests** area, click the ✖ symbol next to the test name.

► To open a test, click the left-pane button with the test name.

► To add the currently opened test to the job, click **Copy test** on the menu bar.

After you have opened a test, the workspace is split into the following areas:

- **Hardware configuration**
  Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Application" on page 102.
- **Settings and conditions**
  Displays the test settings. For the test settings description, see 17 "Application" on page 102.
- **Assessment**
  Provides access to setting the assessment limits. For the assessment limit description, see 15.3 "Assessment limits" on page 91.
- **Measurements**
  Displays the measurement results. For more information, see 13 "Display measurement results" on page 80.

The following figure shows an example of the create new manual tests view if a test is open.

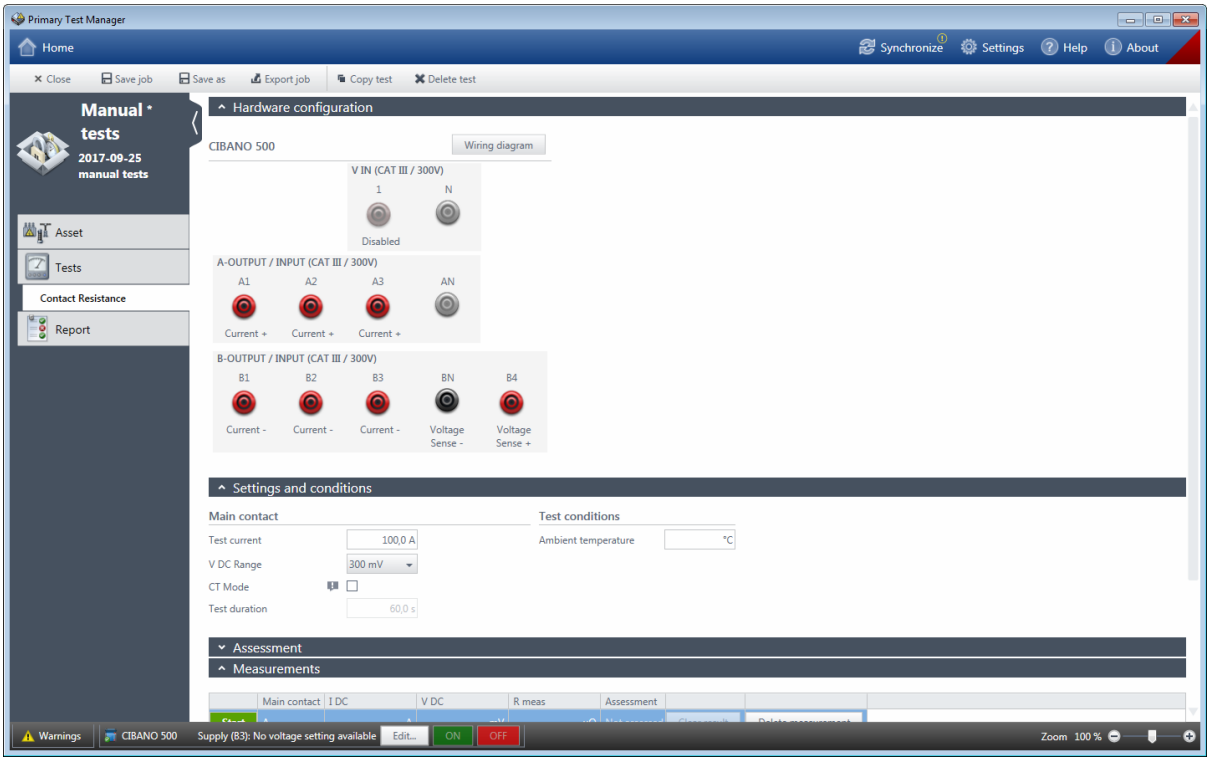


Figure 10-3: A test in the create new manual tests view

If you click the **Tests** button in the left pane, the workspace displays the **Available tests** area and the **Selected tests** area again.

10.2 Process tests

By using the commands on the menu bar, you can process tests. The following table describes the available operations.

Table 10-1: Menu bar commands

Command	Action
Close	Closes the current job and leads you to the *Primary Test Manager* home view. Before closing the job, you can save the changes for all tests.
Save job	Saves the current job. When saving for the first time, you must specify the filename and directory of the job.
Save as	Saves the current job in a newly specified directory.
Export job	Exports the current job into a Microsoft Excel spreadsheet.
Copy test[1]	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Delete test[1]	Deletes the currently open test.

1. Only available if a test is open

Note: Clicking **Home** in the title bar and **Close** in the menu bar have the same functionality.

11 Open manual tests

With *Primary Test Manager*, you can open existing manual tests. To open manual tests:

1. Click the **Open manual tests** button in the home view (see Figure 6-1: "Primary Test Manager home view" on page 31).
2. In the **Open** dialog box, browse to the file you want to open.

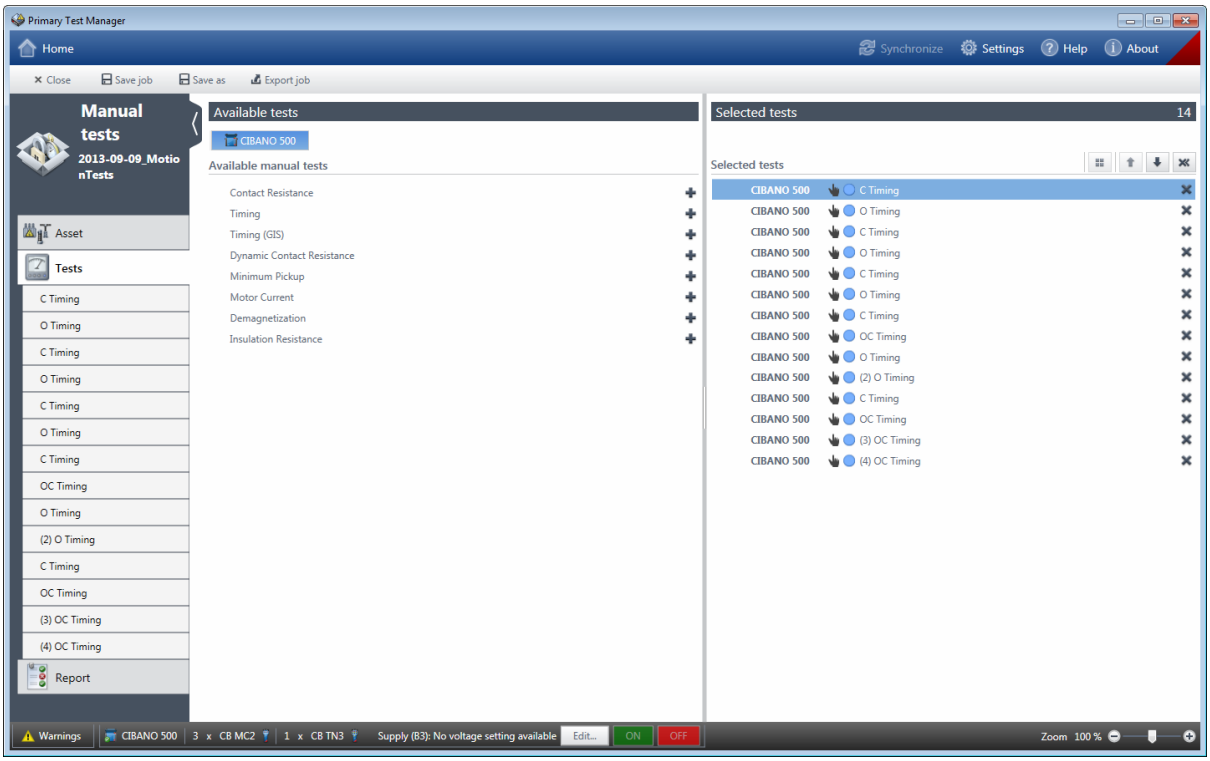


Figure 11-1: Open manual tests view

The open manual tests view displays the tests in the left pane. To view the test results, click the corresponding test button. You can add new tests to the job and process tests as described in 10 "Create new manual tests" on page 73.

Note: The operating times for the Timing test and the Dynamic Contact Resistance test are calculated according to IEC 62271-100 standard. If you open a manual test performed with *Primary Test Manager* version 3.11 and earlier, the operating times are recalculated according to IEC 62271-100. The original data is still available on the **Legacy data** tab in the **Measurements** area. You can delete the original data irreversibly by clicking **Delete legacy data**.

12 Control tests

In the **Measurements** area of *Primary Test Manager*, you can control the test execution and check the circuit breaker state.

Figure 12-1: Part of the **Measurements** area with the test control commands and circuit breaker state indicators

12.1 Test control commands

The following table describes the commands for controlling tests.

Note: Not all test control commands are available for all tests.

Table 12-1: Test control commands

Command	Action
Start/Start all	Starts the selected measurement/all measurements of the currently open test.
Stop/Stop all	Stops the running measurement/measurements.
Clear all	Deletes all measurement results of the currently open test.
Open breaker	Opens the circuit breaker's main contacts.
Close breaker	Closes the circuit breaker's main contacts.
Supply motor	Starts charging the circuit breaker's motor. The measurement stops automatically when the motor is fully charged.
Clear result	Deletes the results of the selected measurement.
Delete measurement	Deletes the selected measurement row.
Add measurement	Adds a new measurement row to the currently open test.
Refresh	Updates the circuit breaker state.

12.2 Checking the circuit breaker state

With *Primary Test Manager*, you can check the circuit breaker state for the following tests:

- 17.1.5 "Timing test with CIBANO 500 with the EtherCAT® module" on page 112
- 17.1.6 "Timing test with CIBANO 500 with the Auxiliary module" on page 120
- 17.5.1 "Timing test" on page 218

Table 12-2: Circuit breaker state indicators

Indicator	Description
	Indicates the open state of the circuit breaker.
	Indicates the closed state of the circuit breaker.
	Indicates that the state of the circuit breaker's phase could not be detected.

Primary Test Manager updates the circuit breaker state automatically after:

- You opened a test with the circuit breaker state indication.
- A measurement has finished.
- You reset or restored the hardware configuration.
- You reconfigured a *CIBANO 500* channel from Main contact *x* to Closed *x*, Motor *x* or Disabled.

You can update the circuit breaker state manually by clicking **Refresh**.

Note: The detection of the circuit breaker state produces clicking sound in *CIBANO 500*.

13 Display measurement results

For some tests, *Primary Test Manager* provides graphical display of measurement results. To display the measurement results graphically, click the **Plot** tab in the **Measurements** area, if available. The graphical display of the measurement results consists of the following parts: cursors, binary traces, and analog traces. *Primary Test Manager* displays the analog traces in the oscilloscope view.

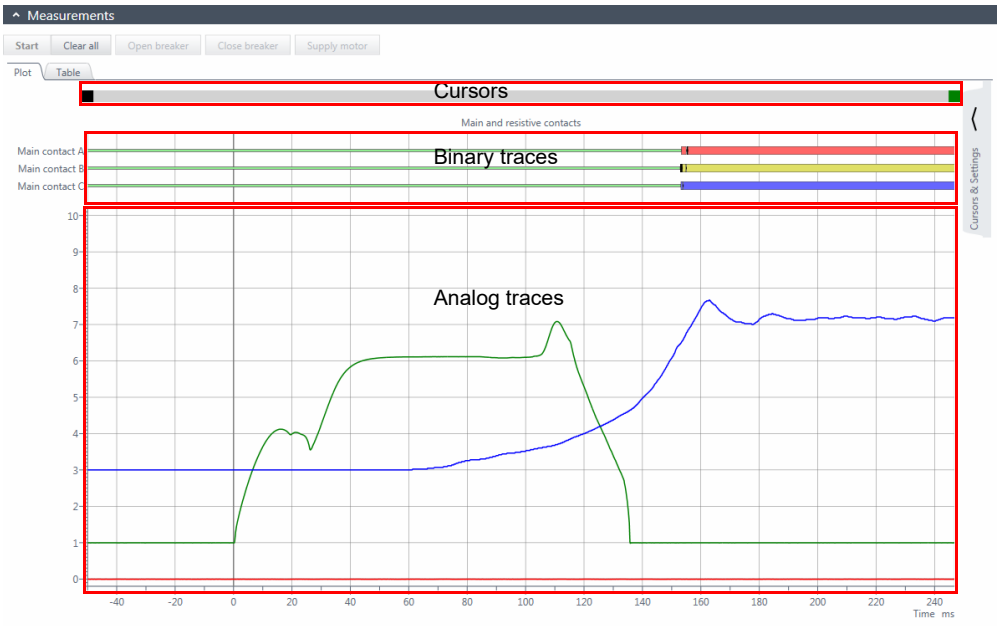


Figure 13-1: Example of the graphical display of measurement data

By clicking the arrow next to **Cursors & Settings** in the upper-right corner of the window, you can open a workspace for setting the cursors and graphical options.

Cursors tab

The graphical display provides two cursors for measuring the analog traces data. To measure the data at any time in the graph, move the cursors in the cursor part of the graphical display. On the **Cursors** tab, you can view the measurement results marked by cursor 1 (C1), the measurement results marked

by cursor 2 (C2), and the difference between the two values (C2–C1). The **Cursors** tab displays the measured analog traces selected on the **Settings** tab (for more information, see "Settings tab" later in this section).

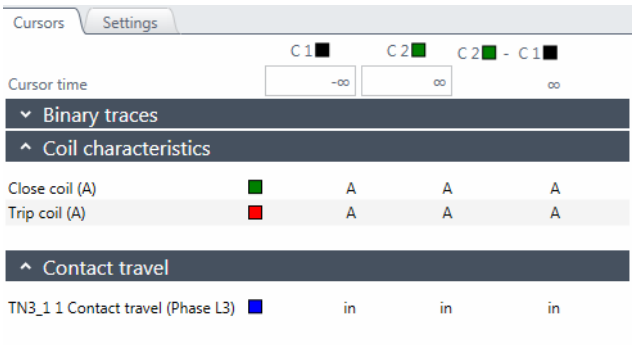


Figure 13-2: Cursors & settings workspace: **Cursors** tab

Settings tab

To set your preferred display options for the analog traces, click the **Settings** tab.

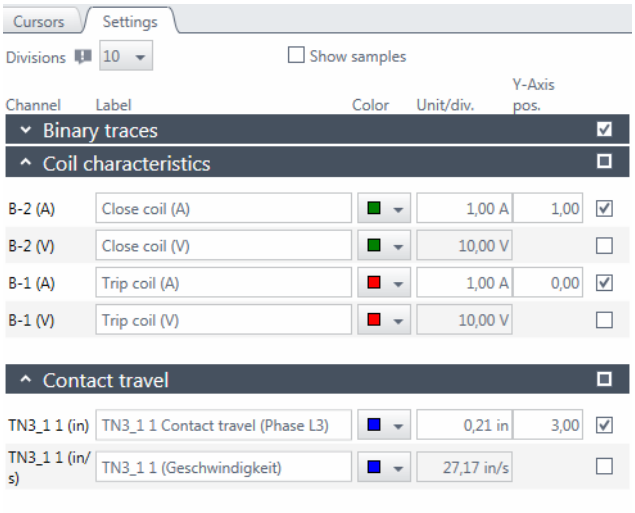


Figure 13-3: Cursors & settings workspace: **Settings** tab

Because the graphical display may contain curves with different units, for example, Volts, Amperes or Ohms, the scale on the Y-axis has no units but a unitless numbers called division (div). On the **Settings** tab, you can set how many, for example, Amperes shows the graphical display per division. As an example, the B-2 (A) channel in Figure 13-1: "Example of the graphical display of measurement data" on page 80 has its highest peak at the seventh division. As the offset on the Y-axis is 1 division and the magnitude is 1 A/div (see Figure Figure 13-3: "Cursors & settings workspace: Settings tab" earlier in this chapter), the peak close coil current is approx. (7–1)×1 = 6 A.

On the **Settings** tab, you can do the following settings.

Table 13-1: Graphical display settings

Setting	Description
Divisions	Number of the graphical display divisions according to the ruler on the Y-axis
Show samples	Select the **Show samples** check box to display only the measured values.
Channel	Channels of *CIBANO 500* and the connected external modules
Label	Editable label of the analog trace
Color	Color of the analog trace
Unit/div.	Number of units per division
Y-axis position	Number of units (offset) the analog trace is displaced from 0
Show	Select the **Show** check box to display the analog trace.

Note: You can save all changes made to the display options on the **Settings** tab. To save the changes you have done, click **Save job** on the menu bar. The changed settings are reflected also in the test reports.

To display the numerical measurement results, click the **Table** tab in the **Measurements** area. For the measurement data description, see "Measurement data" of the relevant test in 17 "Application" on page 102.

14 Generate test reports

In the report view, you can configure and generate test reports. To open the report view, click the **Report** button  in the left pane.

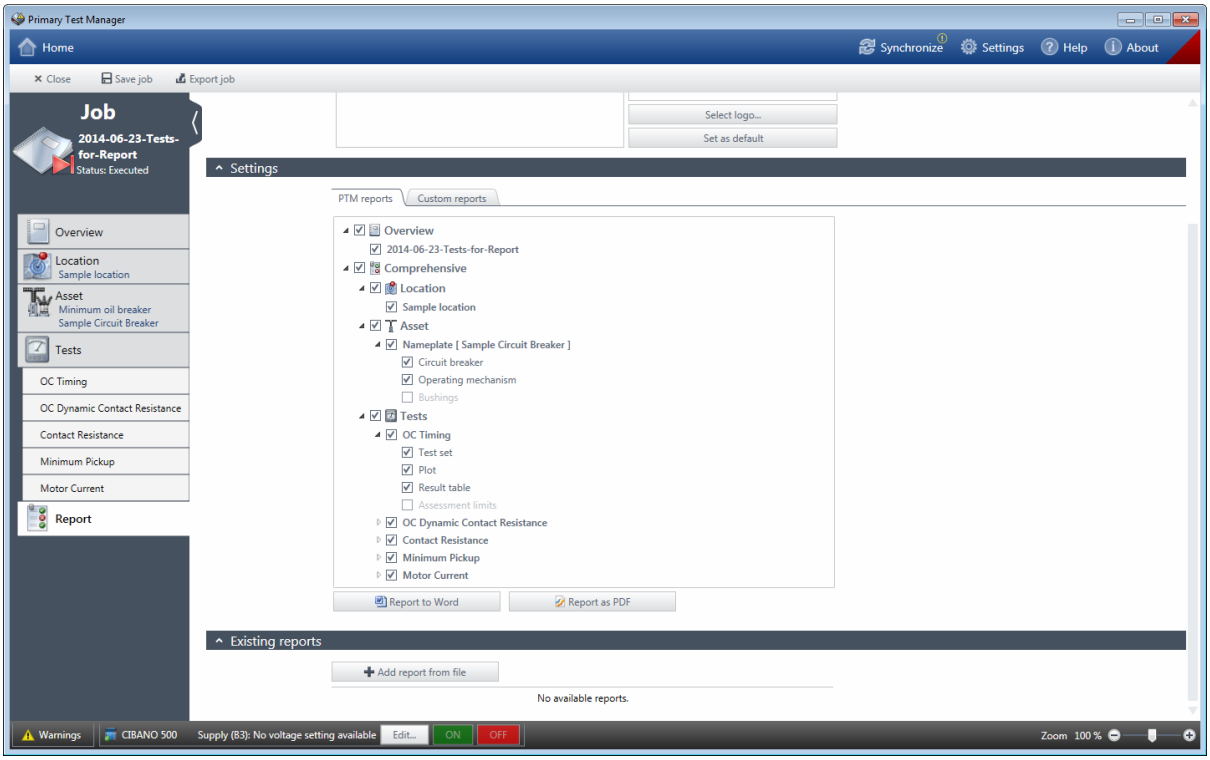


Figure 14-1: Report view

The report view is divided into the **New report** area, the **Settings** area and the **Existing reports** area. In the **New report** area, you can set the report data. The following table describes the report data.

Table 14-1: Report data

Data	Description
Title	Title of the report. Appears as the report header.
Report language	Language the report is created in
Report ID[1]	Identifier of the report
Client	Customer for which the report is designated
Logo	Logo to appear in the report (see "Setting the logo" later in this chapter)
Summary	Text field to summarize the content of the test report in own words.

1. By default generated by *Primary Test Manager*.

Setting the logo

To insert your own logo:

1. In the **New report** area, click **Select image**.
2. In the **Open Image File** dialog box, browse to the file you want to insert.

► To set your own logo as default, click **Set as default**.

In the **Settings** area, you can configure test reports by selecting the respective check boxes. You can generate test reports as Microsoft Word or in PDF format. To generate a test report in your preferred format, click **Report to Word** or **Report as PDF**.

Using the custom Microsoft Excel templates

You can use customized Microsoft Excel templates provided by OMICRON to tailor test reports to your needs. For information about the test report templates, contact your OMICRON local sales representative or distributor. To open a test report template:

1. In the **Settings** area, click the **Custom reports** tab.
2. Click **Select template**.
3. In the **Select** dialog box, browse to the template you want to use.

► To set the customized test report template as default, click **Set as default**.

The **Existing reports** area displays the test reports available for the job. In addition to the test reports generated by *Primary Test Manager*, you can add other reports to jobs. To add a report to a job:

1. In the **Existing reports** area, click **Add report from file**.
2. In the **Add** dialog box, browse to the report you want to add to the job.

15 Circuit breaker data

The following table describes the circuit breaker data.

Table 15-1: Circuit breaker data

Data	Description
Circuit breaker	
Number of phases	Number of the circuit breaker's phases
Number of interrupters per phase	Number of the circuit breaker's interrupters per phase
Pole operation	Pole operation of the circuit breaker
Pre-insertion resistors (PIR)	Select the **Pre-insertion resistors (PIR)** check box if the circuit breaker contains pre-insertion resistors.
PIR value	Pre-insertion resistor value
Grading capacitors	Select the **Grading capacitors** check box if the circuit breaker contains grading capacitors.
Capacitor value	Grading capacitor value
Interrupting medium	Interrupting medium of the circuit breaker
Tank type	Type of the circuit breaker's tank
Ratings	
Rated frequency	Rated frequency of the circuit breaker
Rated voltage L-L	Rated voltage of the circuit breaker
Rated current	Rated current of the circuit breaker
Rated short-circuit breaking current	Rated short-circuit breaking current of the circuit breaker
Short-circuit nominal duration	Nominal duration of the short-circuiting
Rated insulation level (BIL)	Basic impulse level rating of the circuit breaker
Rated interrupting time	Rated interrupting time of the circuit breaker
Interrupting duty cycle	Interrupting duty cycle of the circuit breaker
Rated power at closing	Rated power of the circuit breaker at closing
Rated power at opening	Rated power of the circuit breaker at opening
Rated power at motor charge	Rated power of the circuit breaker at motor charge
Contact system	
Nominal total travel	Total distance traveled by the contact during operation (excluding possible over-travel) For more information, see Figure 17-52: "Contact travel characteristics" on page 222.

Table 15-1: Circuit breaker data (continued)

Data	Description
Damping time	Time in which the damping units are engaged to decelerate the circuit breaker's moving contacts
Nozzle length	Length of the circuit breaker's nozzle
Others[1]	
Total weight with oil/gas	Total weight of the circuit breaker with oil or gas
Weight of oil/gas	Weight of the circuit breaker's oil or gas
Volume of oil/gas	Volume of the circuit breaker's oil or gas
Rated gas pressure	Rated gas pressure of the circuit breaker at given temperature
Comment	Comment on the circuit breaker
Attachments	Attachments to the circuit breaker (see "Managing attachments" later in this chapter)

1. Depending on the circuit breaker type

Managing attachments

Under **Attachments**, you can manage attachments to circuit breakers.

To add an attachment to a circuit breaker:

1. Click the **Add** button ➕.
2. In the **Select Files** dialog box, browse to the file you want to attach to the circuit breaker.

To open an attachment, do one of the following:

► Select the attachment, and then click the **Open** button 🗀.

► Double click the attachment.

To delete an attachment from a circuit breaker:

1. Select the attachment you want to delete.
2. Click the **Remove** button ✖.

15.1 Operating mechanism data

The following table describes the data of the circuit breaker's operating mechanism.

Table 15-2: Operating mechanism data

Data	Description
Number of trip coils	Number of trip coils to operate the circuit breaker
Number of close coils	Number of close coils to operate the circuit breaker
Component	Operating mechanism's component
Rated voltage	Rated voltage of the operating mechanism's component
Rated current	Rated current of the operating mechanism's component
DC	Select the **DC** check box to set the component's DC operation
AC	Select the **AC** check box to set the component's AC operation
Frequency	AC operation frequency
Rated operating pressure[1]	Rated operating pressure of the operating mechanism at given temperature
Conversion tables	
Name	Name of the conversion table
Comment	Comment on the conversion table

1. Only available for the hydraulic and pneumatic operating mechanisms

Conversion tables

To perform motion measurements on a circuit breaker a travel transducer needs to be applied to the mechanical linkage. One goal of the motion measurement method is the assessment of the main contacts within the interrupter unit. However, the interrupter units are not accessible by the motion sensor directly. Therefore the sensors are applied to the connecting rod or the drive lever on the outside of the interrupter unit. In order to still be able to get the motion path of the main contacts, you can calculate it based on the measurements taken by the motion sensor.

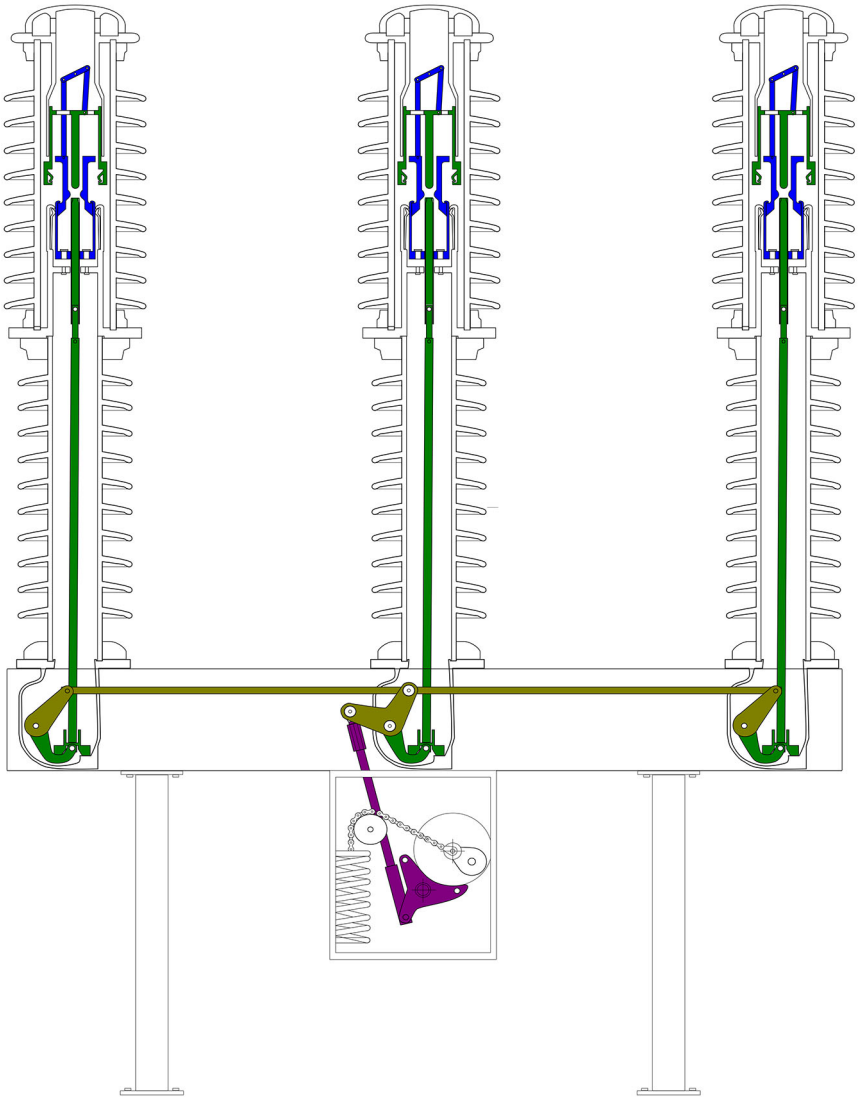


Figure 15-1: Mechanical linkage of a live-tank high-voltage circuit breaker

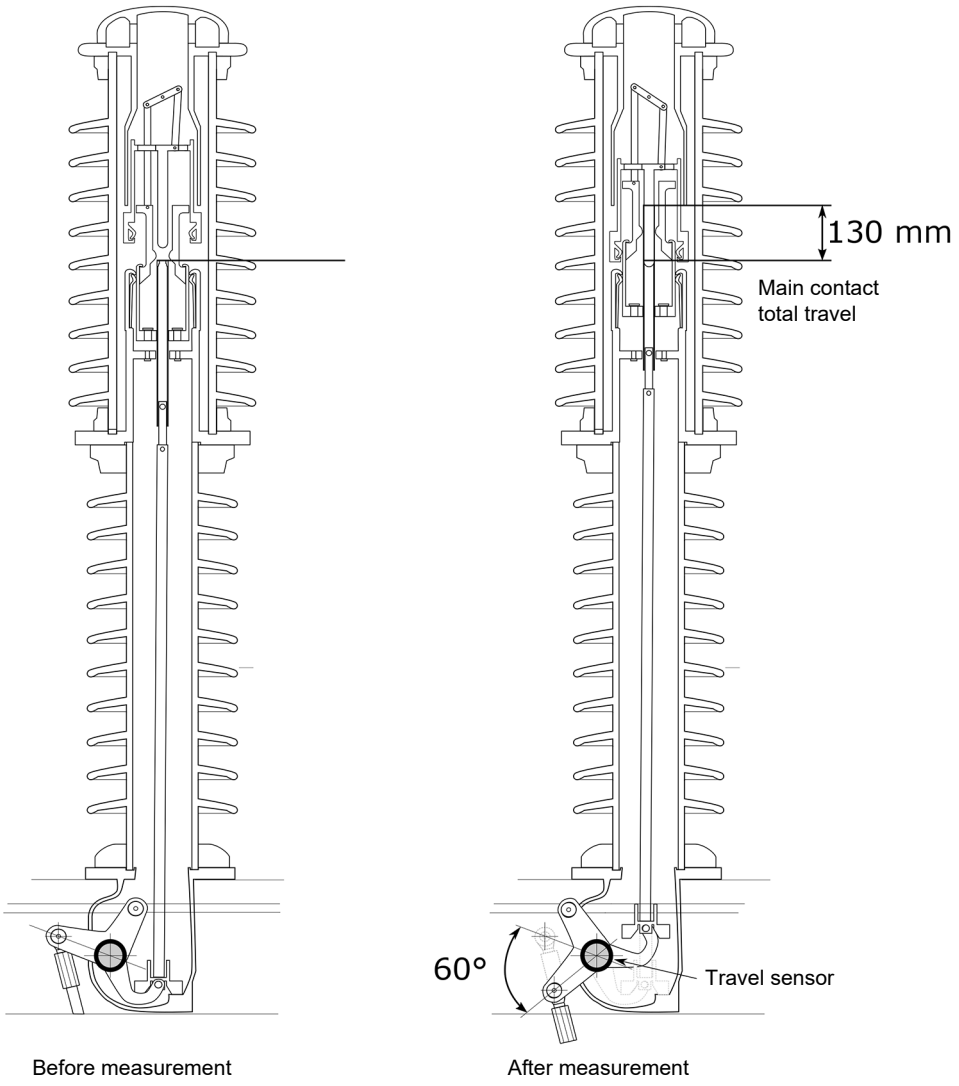


Figure 15-2: 60 degree travel at the travel sensor corresponds to 130 mm travel at the main contacts

For a basic circuit breaker design a contact factor is accurate enough for calculating the path of the main contacts. Use conversion tables if there are more than one lever within the mechanical linkage between the sensors.

Under **Conversion tables**, you can manage conversion tables for the contact travel calculation when using angular transducers. You can load conversion tables in the native Megger format (.tbl) and as comma-separated value files (.csv).

The imported CSV files must comply with a special format in which the first line is reserved for a comment and the second line specifies the units “degree” and “mm” separated by a semicolon (“;”). All following lines consist of one value pair per line that specifies the transducer movement in degrees and the converted movement in millimeters separated by a semicolon. The following example shows the general CSV format structure.

```
comment; THIS IS AN EXAMPLE COMMENT
degree;mm
-10.00;-9.00
-9.90;-8.91
...
119.80;241.14
119.90;241.04
```

To add a conversion table:

1. Click the **Add** button ➕.
2. In the **Open** dialog box, browse to the conversion table you want to add.

Note: To rename a conversion table, click the conversion table, and then edit the conversion table name.

To delete a conversion table, click the **Remove** button ✖ next to the conversion table.

15.2 Bushing data

For the data of the circuit breaker’s bushings, see 16 "Spare bushing data" on page 100.

15.3 Assessment limits

15.3.1 Absolute assessment limits

The following tables describe the circuit breaker's absolute assessment limits.

Table 15-3: Contact resistance

	R min	R max
Contact resistance	Minimum contact resistance	Maximum contact resistance

Table 15-4: Operating times

	t min	t max
Opening time	Minimum operating time of main contacts	Maximum operating time of main contacts
Opening sync. (contacts within a phase)		
Opening sync. (between breaker phases)		
Closing time		
Closing sync. (contacts within a phase)		
Closing sync. (between breaker phases)		
Reclosing time		
Close-Open time		
Open-Close time		

Table 15-5: Contact travel[1]

	d min	d max
Total travel, TT	Minimum distance of the contact travel	Maximum distance of the contact travel
Over-travel (Trip), OT		
Over-travel (Close), OT		
Rebound (Trip), RB		
Rebound (Close), RB		
Contact wipe, CW		
Add velocity zone	Click **Add velocity zone** to define a velocity zone for assessment of the contact travel velocity (see 15.4 "Velocity zones" on page 97).	

1. Only available if testing with the *CB TN3* modules

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-6: Auxiliary contacts: Trip operation

	t min	t max
Switching time (a-type), $t_{switch,a}$	Minimum operating time of auxiliary contacts	Maximum operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-7: Auxiliary contacts: Close operation

	t min	t max
Switching time (a-type), $t_{switch,a}$	Minimum operating time of auxiliary contacts	Maximum operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-8: Miscellaneous

	Minimum	Maximum
Bounce time	Minimum duration of the main contact bounce	Maximum duration of the main contact bounce
Bounce count	Minimum number of main contact bounces within the bounce time	Maximum number of main contact bounces within the bounce time
PIR closing time	Minimum closing time for pre-insertion resistors	Maximum closing time for pre-insertion resistors

Table 15-9: Coil currents

	I min	I max
Peak close coil current	Minimum coil current	Maximum coil current
Peak trip coil current		

Table 15-10: Pickup voltage

	V min	V max
Minimum pickup voltage (close)	Minimum pickup voltage	Maximum pickup voltage
Minimum pickup voltage (trip)		

Table 15-11: Motor characteristics

	Minimum	Maximum
Inrush current	Minimum motor characteristic	Maximum motor characteristic
Charging time		

15.3.2 Relative assessment limits

The following tables describe the circuit breaker's relative assessment limits.

Table 15-12: Contact resistance

	R ref	R dev
Contact resistance	Reference contact resistance	Allowed deviation from the reference contact resistance

Table 15-13: Operating times

	t ref	–t dev	+t dev
Opening time	Reference operating time of main contacts	Allowed negative deviation from the reference operating time of main contacts	Allowed positive deviation from the reference operating time of main contacts
Opening sync. (contacts within a phase)			
Opening sync. (between breaker phases)			
Closing time			
Closing sync. (contacts within a phase)			
Closing sync. (between breaker phases)			
Reclosing time			
Close-Open time			
Open-Close time			

Table 15-14: Contact travel[1]

	d ref	d dev
Total travel, TT	Reference distance of the contact travel	Allowed deviation from the reference distance of the contact travel
Over-travel (Trip), OT		
Over-travel (Close), OT		
Rebound (Trip), RB		
Rebound (Close), RB		
Contact wipe, CW		
Add velocity zone	Click **Add velocity zone** to define a velocity zone for assessment of the contact travel velocity (see 15.4 "Velocity zones" on page 97).	

1. Only available if testing with the *CB TN3* modules

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-15: Auxiliary contacts: Trip operation

	t ref	t dev
Switching time (a-type), $t_{switch,a}$	Reference operating time of auxiliary contacts	Allowed deviation from the reference operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-16: Auxiliary contacts: Close operation

	t ref	t dev
Switching time (a-type), $t_{switch,a}$	Reference operating time of auxiliary contacts	Allowed deviation from the reference operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click More information to open a diagram explaining the characteristics described in the table.

Table 15-17: Miscellaneous

	Reference	Deviation
Bounce time	Reference duration of the main contact bounce	Allowed deviation from the reference bounce time
Bounce count	Reference number of main contact bounces within the bounce time	Allowed deviation from the reference bounce count
PIR closing time	Minimum closing time for pre-insertion resistors	Maximum closing time for pre-insertion resistors

Table 15-18: Coil currents

	I ref	–I dev	+I dev
Peak close coil current	Reference coil current	Allowed negative deviation from the reference coil current	Allowed positive deviation from the reference coil current
Peak trip coil current			

Table 15-19: Pickup voltage

	V ref	V dev
Minimum pickup voltage (close)	Reference pickup voltage	Allowed deviation from the reference pickup voltage
Minimum pickup voltage (trip)		

Table 15-20: Motor characteristics

	Reference	Deviation
Inrush current	Reference motor characteristic	Allowed deviation from the reference motor characteristic
Charging time		

15.4 Velocity zones

To add a new zone for assessment of the contact travel velocity:

1. Under **Contact travel**, click **Add velocity zone**.
2. In the **Define New Velocity Zone** dialog box, set the configuration settings.

The following table describes the configuration settings of the velocity zones.

Table 15-21: Velocity zone settings

Setting	**Description**	
Operation	Trip	
		Parameters
Zone start	Contact break	no offset
		Distance (absolute)
		Distance (% of total travel)
		Time
	Initial contact position	Distance (absolute)
		Distance (% of total travel)
	Final contact position	Distance (absolute)
		Distance (% of total travel)
	Sequence start (t=0)	no offset
		Time
		Parameters

Table 15-21: Velocity zone settings (continued)

Setting	Description	
Zone end	Contact break	no offset
		Distance (absolute)
		Distance (% of total travel)
		Time
	Initial contact position	Distance (absolute)
		Distance (% of total travel)
	Final contact position	Distance (absolute)
		Distance (% of total travel)
	Sequence start (t=0)	no offset
		Time
	Zone start	Distance (absolute)
		Distance (% of total travel)
		Time
Operation	Close	
		Parameters
Zone start	Contact make	no offset
		Distance (absolute)
		Distance (% of total travel)
		Time
	Initial contact position	Distance (absolute)
		Distance (% of total travel)
	Final contact position	Distance (absolute)
		Distance (% of total travel)
	Sequence start (t=0)	no offset
		Time
		Parameters

Table 15-21: Velocity zone settings (continued)

Setting	Description	
Zone end	Contact make	no offset
		Distance (absolute)
		Distance (% of total travel)
		Time
	Initial contact position	Distance (absolute)
		Distance (% of total travel)
	Final contact position	Distance (absolute)
		Distance (% of total travel)
	Sequence start (t=0)	no offset
		Time
	Zone start	Distance (absolute)
		Distance (% of total travel)
		Time

Note: For the definitions of the velocity zone settings, see the graphic preview in the **Define New Velocity Zone** dialog box.

16 Spare bushing data

The following table describes the spare bushing data.

Table 16-1: Spare bushing data

Data	Description
Pos.[1]	Terminal of the asset to which the spare bushing is connected
Ratings	
Rated frequency	Rated frequency of the spare bushing
Insul. level LL (BIL)	L-L basic impulse level rating of the spare bushing
Voltage L-ground	Rated line-to-ground voltage
Max. system voltage	Maximum voltage between phases during normal service
Rated current	Rating current of the spare bushing
Manufacturer info	
Catalog no.	Catalog number of the spare bushing
Drawing no.	Drawing number of the spare bushing
Style no.	Style number of the spare bushing
Nominal values	
PF (C1)/ DF (C1)/ Tanδ (C1)[2]	Power factor, dissipation factor, or tangent delta of the capacitance C1 between the top of the spare bushing and the voltage/test tap
Cap. (C1)	Capacitance C1 between the top of the spare bushing and the voltage/test tap
PF (C2)/ DF (C2)/ Tanδ (C2)[2]	Power factor, dissipation factor, or tangent delta of the capacitance C2 between the voltage/test tap of the spare bushing and ground
Cap. (C2)	Capacitance C2 between the voltage/test tap of the spare bushing and ground
Other	
Insulation type	Insulation type of the spare bushing
Outer insulation type	Outer insulation type of the spare bushing
Comment	Comment on the spare bushing
Attachments	Attachments to the spare bushing (see "Managing attachments" later in this chapter)

1. Only available for spare bushings mounted on another assets
2. Set by the selected profile

Managing attachments

Under **Attachments**, you can manage attachments to spare bushings.

To add an attachment to a spare bushing:

1. Click the **Add** button ➕.
2. In the **Select Files** dialog box, browse to the file you want to attach to the spare bushing.

To open an attachment, do one of the following:

► Select the attachment, and then click the **Open** button 🗀.

► Double click the attachment.

To delete an attachment from a spare bushing:

1. Select the attachment you want to delete.
2. Click the **Remove** button ✖.

17 Application

This section describes testing of circuit breakers with *CIBANO 500* and its accessories. *Primary Test Manager* in combination with *CIBANO 500* supports the following circuit breaker tests:

- Contact Resistance
- Timing
- Dynamic Contact Resistance
- Minimum Pickup
- Motor Current
- Insulation Resistance
- Timing (GIS)
- Demagnetization

The tests are grouped according to their application areas in:

- 17.1 "Testing medium-voltage circuit breakers" on page 103
- 17.2 "Testing high-voltage circuit breakers" on page 140
- 17.3 "Testing gas insulated switchgears with both sides grounded" on page 186
- 17.4 "Demagnetization" on page 212
- 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 218

Note: You can configure the tests in different ways as described earlier in this User Manual. For conciseness, the wording *open the test* in the application procedures means clicking the test in the *Primary Test Manager* workspace independently of how the test has been configured.

17.1 Testing medium-voltage circuit breakers

The medium-voltage (MV) circuit breakers are typically tested with *CIBANO 500* only (without the *CB MC2* modules). If you want to test the MV circuit breakers with the *CB MC2* modules, see 17.2 "Testing high-voltage circuit breakers" on page 140.

17.1.1 Safety precautions in the substation

Always observe the following safety rules:

- ► Disconnect completely.
- ► Secure against re-connection.
- ► Verify that the installation is dead.
- ► Carry out grounding and short-circuiting.
- ► Provide protection against adjacent live parts.
- ► Ground the test object at one or more terminals during connecting, testing and disconnecting.

Separate your working area as shown in Figure 1-1: "Example of the separation of the safe and high-voltage test areas" on page 10 into a safe area and a high-voltage test area when a test is running.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Never use the *CIBANO 500* test set without a solid connection to ground.
- ► Ground *CIBANO 500* with a cable of at least 6 mm^2 cross-section as close as possible to the operator.

Typical MV circuit breakers are opened and then removed from the rack according to the specifications of the circuit breaker manufacturer and the substation regulations. We recommend disconnecting the circuit breaker completely from the station, including the secondary connections, and to ground the circuit breaker on one side. Because you can use *CIBANO 500* to supply the circuit breaker during the test, in this way the maximum safety is guaranteed.

17.1.2 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on *CIBANO 500* by pressing the mains power on/off switch on the side panel. The green warning light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of CIBANO 500" on page 15) flashes for a short time and then extinguishes for approximately one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to CIBANO 500" on page 26.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then do one of the following:

► Click **More** beneath the **Connect** button, and then click **Refresh**.

► Press F5.

Figure 17-1: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 19.1 "Connecting to *CIBANO 500*" on page 243.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new jobs (see 7 "Create new job" on page 46)
- Execute prepared jobs (see 8 "Execute prepared job" on page 65)
- Manage locations, assets, jobs and test reports (see 9 "Manage objects" on page 66)
- Create new manual tests (see 10 "Create new manual tests" on page 73)
- Open existing manual tests (see 11 "Open manual tests" on page 77)
- Generate test reports (see 14 "Generate test reports" on page 83)

The next sections describe the MV circuit breaker tests.

17.1.3 Test group execution

Primary Test Manager provides you with a powerful capability for executing test groups. For information on grouping tests in test groups, see 7.5.2 "Grouping tests" on page 61. After you set the hardware configuration of the test set and the test group settings, you can execute all tests of the test group automatically by clicking the **Start all** button.

To execute a test group:

1. Group tests in a test group (see 7.5.2 "Grouping tests" on page 61).
2. Connect the test object to *CIBANO 500*.
3. In *Primary Test Manager*, open the test group you want to execute.
4. In the **Hardware configuration** area, set the hardware configuration. For the hardware configuration options of *CIBANO 500*, see Table 17-5: "Hardware configuration options of CIBANO 500" on page 112.

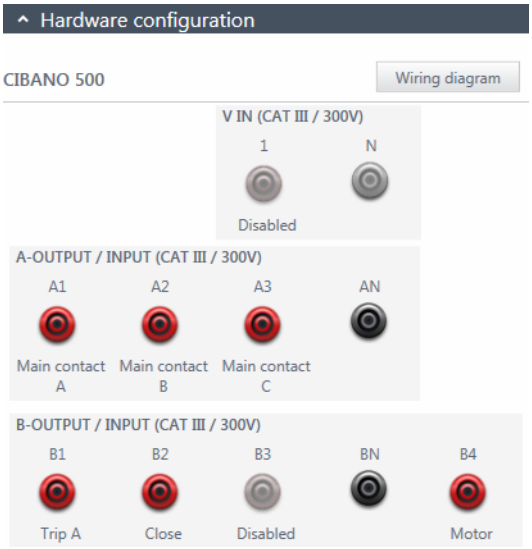


Figure 17-2: Hardware configuration of the test set for a test group

5. In the **Settings and conditions** area, enter the test group settings.

Table 17-1: Test group settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source

6. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Test control** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether your *CIBANO 500* is properly wired with the test object.

7. In the **Test control** area, click **Start all**.
   The blue ring on the **Measurement Start/Stop** button is on.

8. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel or click **Stop all** in *Primary Test Manager*.

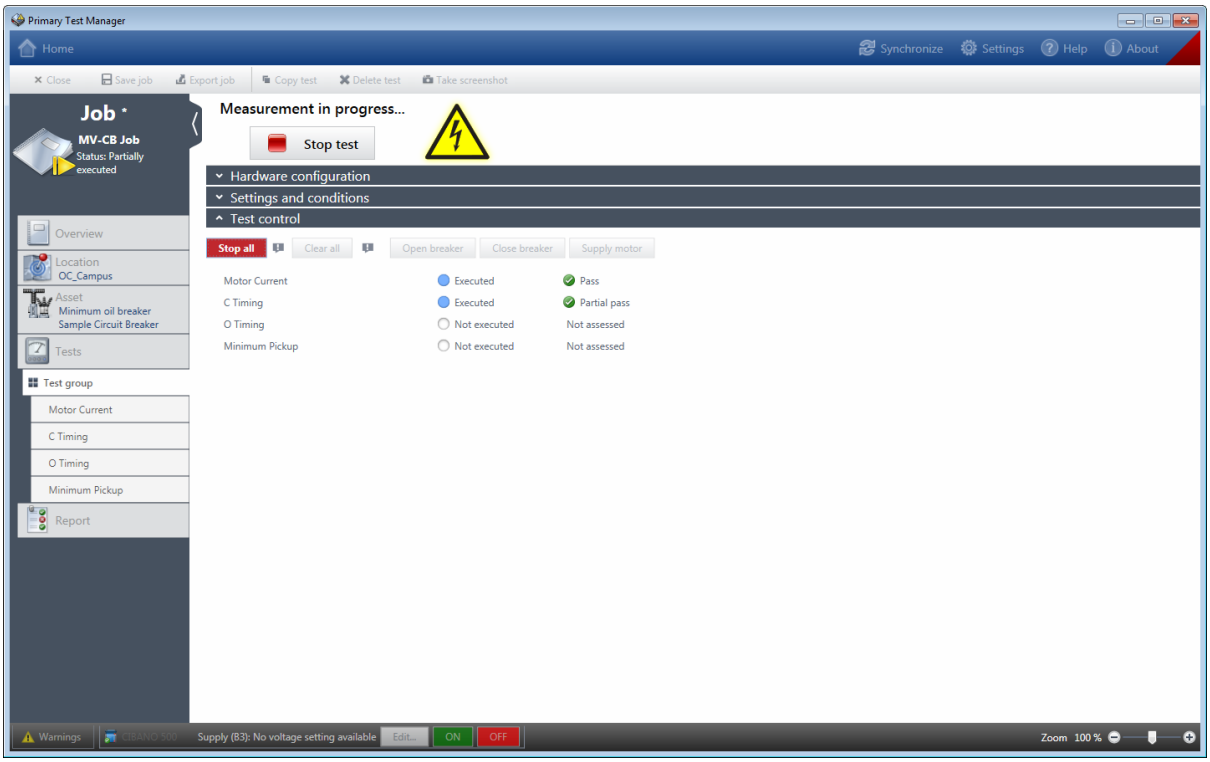


Figure 17-3: Test group execution

9. *Primary Test Manager* executes the tests of the test group sequentially. Before a test is executed, the circuit breaker is brought into the required state and the motor is supplied. After a test has been executed, *Primary Test Manager* displays the execution and assessment status if the **Automatic assessment** check box is selected in the tests.

   Note: If a test in the test group is invalid, it will be skipped during the test group execution. You can remove invalid tests before or after executing the test group.

10. After the test execution has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green warning light is on.

17.1.4 Contact Resistance test

The Contact Resistance test measures the static resistance of the circuit breaker's main contacts.

The Contact Resistance test can be performed only when the circuit breaker is closed. A typical MV circuit breaker has manual operation buttons at its front plate to control the circuit breaker's spring. If the spring is not charged, first charge the spring as described in 17.1.9 "Motor Current test" on page 132, and then close the circuit breaker. Do not open the circuit breaker now again.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not use external power sources for the circuit breaker's main contacts.
- ► During the test, supply the circuit breaker's main contacts only with *CIBANO 500*.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Contact Resistance test.

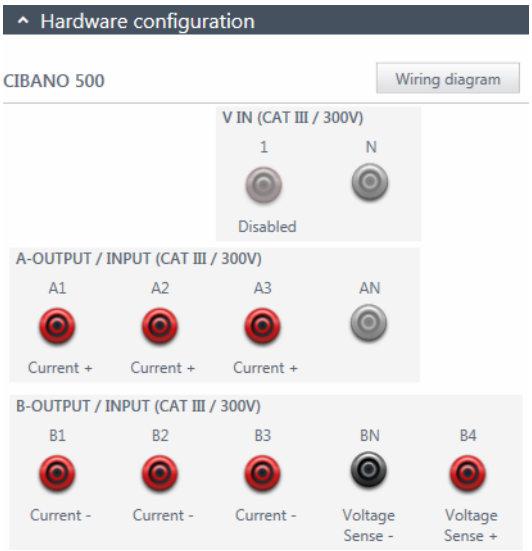


Figure 17-4: Hardware configuration of the Contact Resistance test

Table 17-2: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Current +
A2	Current +
A3	Current +
AN	Not connected in this test

Table 17-2: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Current –
B2	Current –
B3	Current –
BN	Voltage Sense –
B4	Voltage Sense +

2. Make sure that all cable connectors are clean and dry before being tightly connected.
3. Connect *CIBANO 500* to the main contact of the circuit breaker for one phase according to the wiring diagram displayed in *Primary Test Manager*.

Tips & Tricks: For easy connection use the delivered multi-core cables and connect the end with the short wires to the *CIBANO 500* sockets according to the short-wire labels. Connect the cable end with the long wires according to the wiring diagram to the corresponding Kelvin clamp. The black **AN** cable is not needed for this test and remains unconnected.

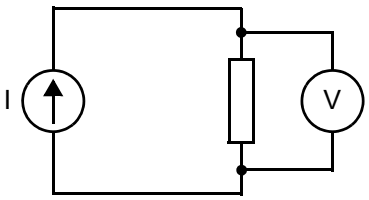


Figure 17-5: Principal scheme of the contact resistance test

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. We recommend using only the red connectors of the Kelvin clamps (which is the current path) when connecting to the contact fingers of a MV circuit breaker. Use a separate clamp for the voltage sense cables (**BN** and **B4**) which can be mounted closer to the MV circuit breaker contact. If the connection is set up properly the resistance decreases when the voltage sense clamps are connected closer to the circuit breaker contact. The polarity of connection does not matter for this test.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Contact Resistance test.

Table 17-3: Contact Resistance test settings

Setting	Description
Main contact	
Test current[1]	Current of the test (typically 100 A)
V DC range[2]	DC voltage measurement range
CT mode[3,4]	Select the **Enabled** check box to enable CT mode for measuring circuit breakers with current transformers (CT).
Test duration[4]	Duration of the test
Test conditions	
Ambient temperature[5]	Ambient temperature on site

1. For normal circuit breakers always use 100 A.
2. For normal circuit breakers the lowest range is recommended. Only if the result is “infinite” select a higher range.
3. Data taken from the nameplate (for circuit breakers with dead tank and GIS)
4. Only available for circuit breakers with integrated current transformer, such as dead-tank and GIS
5. Only for reference in the report, the result is not temperature compensated.

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

5. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

Table 17-4: Contact Resistance measurement data

Data	Description
Main contact	Main contact of the circuit breaker under test
I DC	DC test current
V DC	Measured voltage
R meas	Measured resistance
Assessment	Measurement assessment

6. Connect *CIBANO 500* to the main contact of the circuit breaker for the next phase according to the wiring diagram provided by *Primary Test Manager*. To display the wiring diagram, click the **Wiring diagram** button. Click in the diagram to close it.
7. Repeat steps 1 to 6 for other two phases.

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 135.

17.1.5 Timing test with *CIBANO 500* with the EtherCAT® module

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence all relevant timing values are automatically calculated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Timing test.
2. In the **Hardware configuration** area, set the hardware configuration.

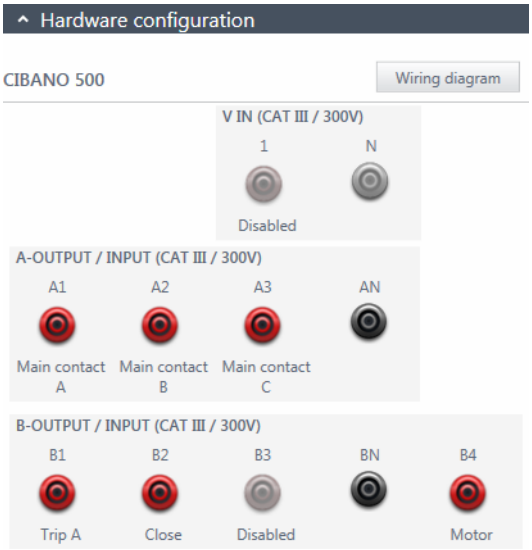


Figure 17-6: Hardware configuration of the Timing test

Table 17-5: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Main contact A, close A, motor A, or disabled
A2	Main contact B, close B, motor B, or disabled
A3	Main contact C, close C, motor C, or disabled
AN	Common neutral connection for outputs/inputs in group **A**

Table 17-5: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, I clamp 1, or disabled
B2	Trip B, I clamp 2, close, or disabled
B3	Trip C, I clamp 3, supply, or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor, I clamp 4, or disabled

3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

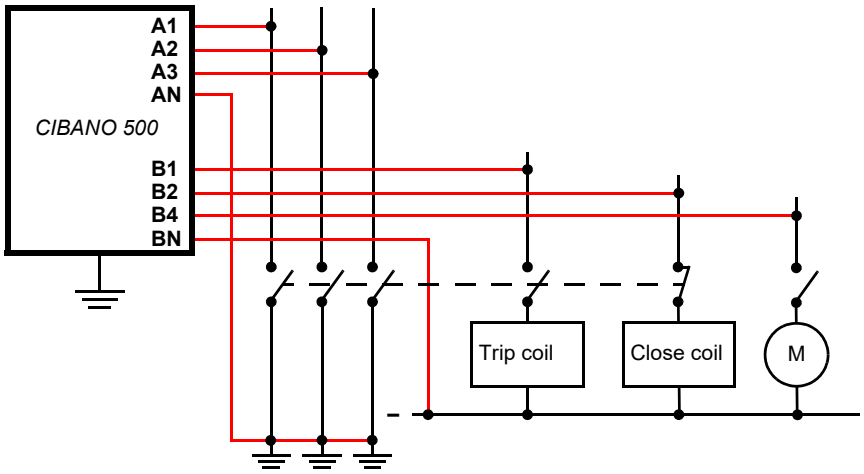


Figure 17-7: Connecting *CIBANO 500* to the circuit breaker for the Timing test

NOTICE

Equipment damage or loss of data possible

- ► Never connect *CIBANO 500* between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.
- ► Connect *CIBANO 500* to the circuit breaker as shown in Figure 17-7: "Connecting CIBANO 500 to the circuit breaker for the Timing test".

NOTICE

Equipment damage or loss of data possible

- ► Do not connect the DC coils with false polarity to prevent damaging the free running diodes.
- ► Always observe the right polarity of the DC coils.

5. Depending on the test requirements, connect *CIBANO 500* to the motor of the circuit breaker.
6. In a typical test of a MV circuit breaker the motor is supplied from *CIBANO 500*. To do so, click the **B4** socket in the hardware configuration, and then click **Motor**. After that connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "–" or neutral contact of the motor.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-6: Timing test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Measure PIR	Select the **Measure PIR** check box to measure timing of the pre-insertion resistors.
Other	
Close breaker before test[4]	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.

Table 17-6: Timing test settings (continued)

Setting	Description
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Sequence	
O	Perform an open sequence
C	Perform a close sequence
OC[5]	Perform a reclose sequence
CO[5]	Perform a trip-free sequence
O-CO[5]	Perform an autoreclose sequence
CO-CO[6]	Perform a CO-CO sequence
O-CO-CO[6]	Perform an O-CO-CO sequence

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. The **Close breaker before test** check box is only active if the test sequence begins with the open command.
5. See Table 17-7: "Timing test sequences" on page 115.
6. Not recommended for MV circuit breakers

The following table explains the sequences of the Timing test.

Table 17-7: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.

Table 17-7: Timing test sequences (continued)

Sequence	Action
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test an O sequence, the circuit breaker must be closed and the spring charged.
4. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.
   The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-8: Operating times

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation[1]
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation[1]
Closing time	Contact closing time of C, CO and O-CO operation[1]
Closing sync.	Closing synchronization time of C, CO and O-CO operation[1]
Reclosing time	Contact reclosing time of OC operation[1]
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation[1]
Close-open time 1	Contact close-open time of CO and O-CO operation[1]
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation[1]
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-9: Auxiliary contact characteristics[1]

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-10: Main contact characteristics

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time[1]	Duration of the main contact bounce
Bounce count[1]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

Table 17-11: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Assessment	Assessment of coil characteristics

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 135.

17.1.6 Timing test with *CIBANO 500* with the Auxiliary module

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence all relevant timing values are automatically calculated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Timing test.
2. In the **Hardware configuration** area, set the hardware configuration.

Figure 17-8: Hardware configuration of the Timing test

Table 17-12: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source or disabled		
N	Neutral connection of **V IN**		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	Main contact A, close A, motor A, or disabled		
A2	Main contact B, close B, motor B, or disabled		
A3	Main contact C, close C, motor C, or disabled		
AN	Common neutral connection for outputs/inputs in group **A**		
B-OUTPUT / INPUT (CAT III / 300 V)			
B1	Trip A, I clamp 1, or disabled		
B2	Trip B, I clamp 2, close, or disabled		
B3	Trip C, I clamp 3, supply, or disabled		
BN	Neutral connection of outputs in group **B**		
B4	Motor, I clamp 4, or disabled		
C-INPUT (CAT III / 300 V)			
C1	AUX 1	Dry contact (potential-free)	or disabled
		Wet contact (with potential)	
C2	AUX 2	Dry contact (potential-free)	or disabled
		Wet contact (with potential)	
C3	AUX 3	Dry contact (potential-free)	or disabled
		Wet contact (with potential)	
CN	Neutral connection of inputs in group **C**		

3. Make sure that all cable connectors are clean and dry before being tightly connected.

4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

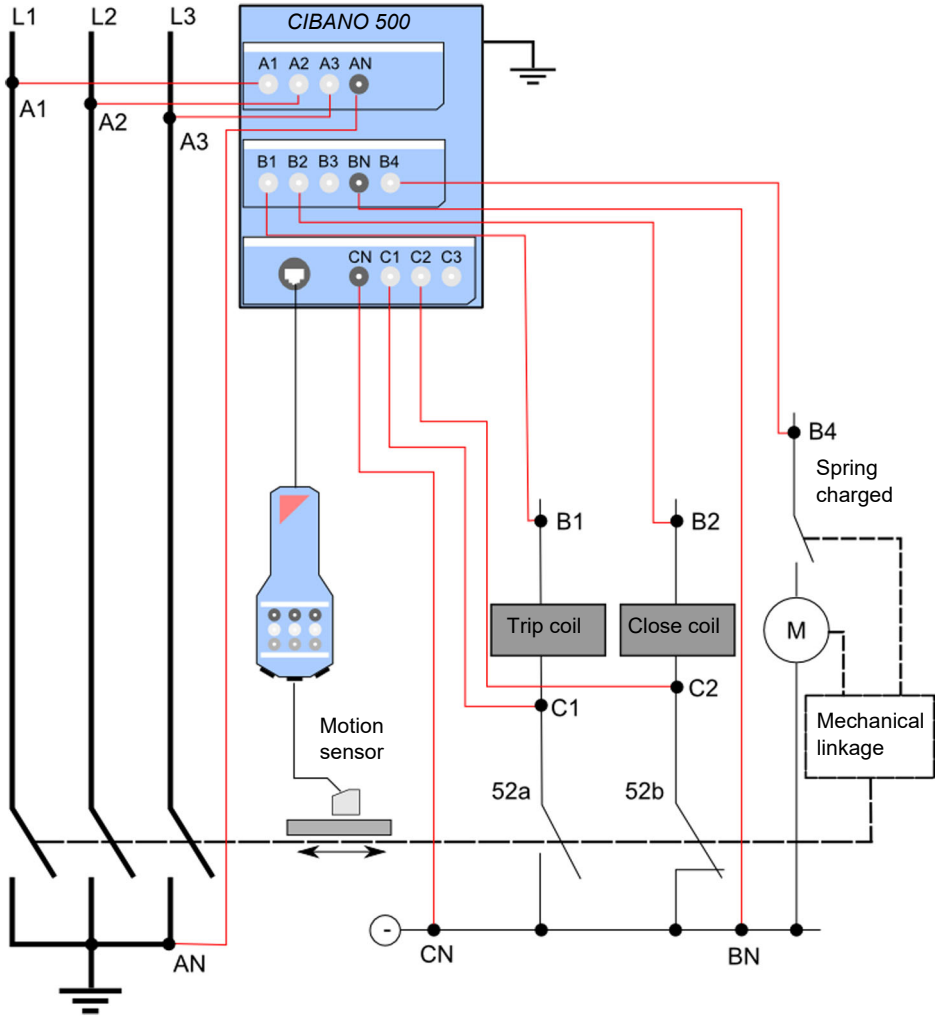


Figure 17-9: Connecting *CIBANO 500* to the circuit breaker for the Timing test

NOTICE

Equipment damage or loss of data possible

- ► Never connect *CIBANO 500* between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.
- ► Connect *CIBANO 500* to the circuit breaker as shown in Figure 17-9: "Connecting CIBANO 500 to the circuit breaker for the Timing test".

NOTICE

Equipment damage or loss of data possible

► Do not connect the DC coils with false polarity to prevent damaging the free running diodes.

► Always observe the right polarity of the DC coils.

5. Depending on the test requirements, connect *CIBANO 500* to the motor of the circuit breaker.
6. In a typical test of a MV circuit breaker the motor is supplied from *CIBANO 500*. To do so, click the **B4** socket in the hardware configuration, and then click **Motor**. After that connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "–" or neutral contact of the motor.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-13: Timing test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Measure PIR	Select the **Measure PIR** check box to measure timing of the pre-insertion resistors.
Other	
Close breaker before test[4]	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Motor supply	

Table 17-13: Timing test settings (continued)

Setting	Description
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Sequence	
O	Perform an open sequence
C	Perform a close sequence
OC[5]	Perform a reclose sequence
CO[5]	Perform a trip-free sequence
O-CO[5]	Perform an autoreclose sequence
CO-CO[6]	Perform a CO-CO sequence
O-CO-CO[6]	Perform an O-CO-CO sequence

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. The **Close breaker before test** check box is only active if the test sequence begins with the open command.
5. See Table 17-7: "Timing test sequences" on page 115.
6. Not recommended for MV circuit breakers

The following table explains the sequences of the Timing test.

Table 17-14: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.

Table 17-14: Timing test sequences (continued)

Sequence	Action
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test an O sequence, the circuit breaker must be closed and the spring charged.
4. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.
   The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-15: Operating times

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation[1]
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation[1]
Closing time	Contact closing time of C, CO and O-CO operation[1]
Closing sync.	Closing synchronization time of C, CO and O-CO operation[1]
Reclosing time	Contact reclosing time of OC operation[1]
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation[1]
Close-open time 1	Contact close-open time of CO and O-CO operation[1]
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation[1]
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-16: Auxiliary contact characteristics[1]

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-17: Main contact characteristics

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time[1]	Duration of the main contact bounce
Bounce count[1]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

Table 17-18: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Assessment	Assessment of coil characteristics

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 135.

17.1.7 Dynamic Contact Resistance test

The Dynamic Contact Resistance test is typically not done on MV circuit breakers and can be performed only with the *CB MC2* modules in connection with *CIBANO 500*. For more information, see 17.2.7 "Dynamic Contact Resistance test" on page 164.

17.1.8 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
   Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

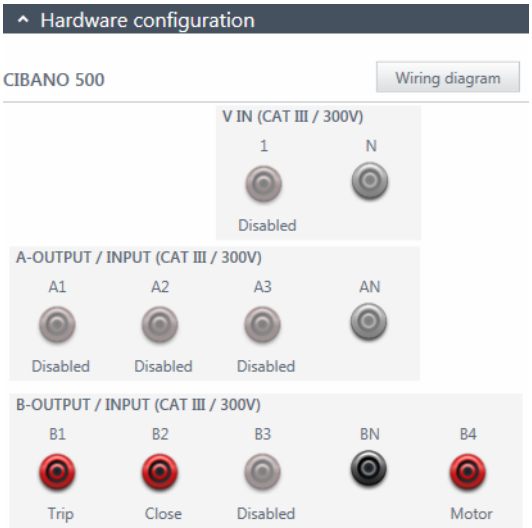


Figure 17-10: Hardware configuration of the Minimum Pickup test

Table 17-19: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)[1]	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled
A3	Motor C or disabled
AN	Common neutral connection for outputs in group **A**

Table 17-19: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Common neutral connection for outputs in group **B**
B4	Motor or disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.

3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-20: Minimum Pickup test settings

Setting	Description
Coil supply	
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Supply during coil supply	
Enable	Select the **Enable** check box to supply voltage on the **B3** socket during test execution.[3]
Supply voltage	Voltage supplied on the **B3** socket (same as the coil supply voltage)
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Command impulse duration	Duration of the command pulse of the automated test sequence

Table 17-20: Minimum Pickup test settings (continued)

Setting	Description
Pause between impulses	Time interval between impulses of the automated test sequence
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[2,4]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.
4. Only available if *CIBANO 500* is selected as source

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.

4. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

   Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

Table 17-21: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 135.

17.1.9 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "–" or neutral contact of the motor.

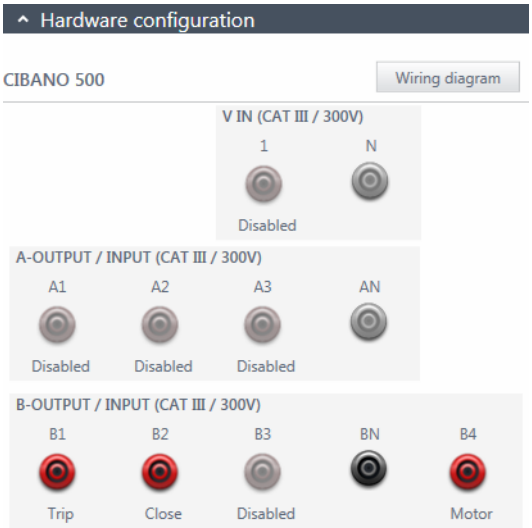


Figure 17-11: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-22: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled

Table 17-22: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
A3	Motor C or disabled
AN	Common neutral connection for outputs/inputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor or disabled

4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect *CIBANO 500* to the motor of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

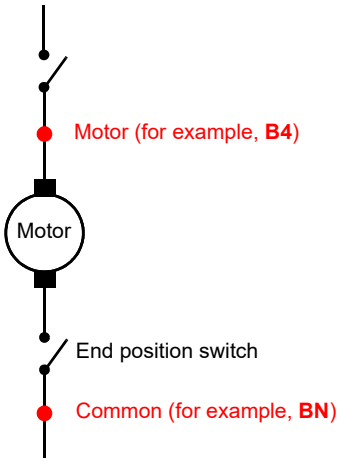


Figure 17-12: Connecting *CIBANO 500* to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-23: Motor Current test settings

Setting	Description
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[1,2]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[1]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils externally.
Supply setting[3]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[1]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[1]	Coil supply frequency (AC only)
Other	
Sample rate	Measurement sample rate

1. Data taken from the nameplate
2. Only available if *CIBANO 500* is selected as source
3. Only available in the guided test workflow

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.

5. After the charging process has finished, *CIBANO 500* stops the measurement automatically.
   The lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

The following figure shows an example of the Motor Current test graphical results.

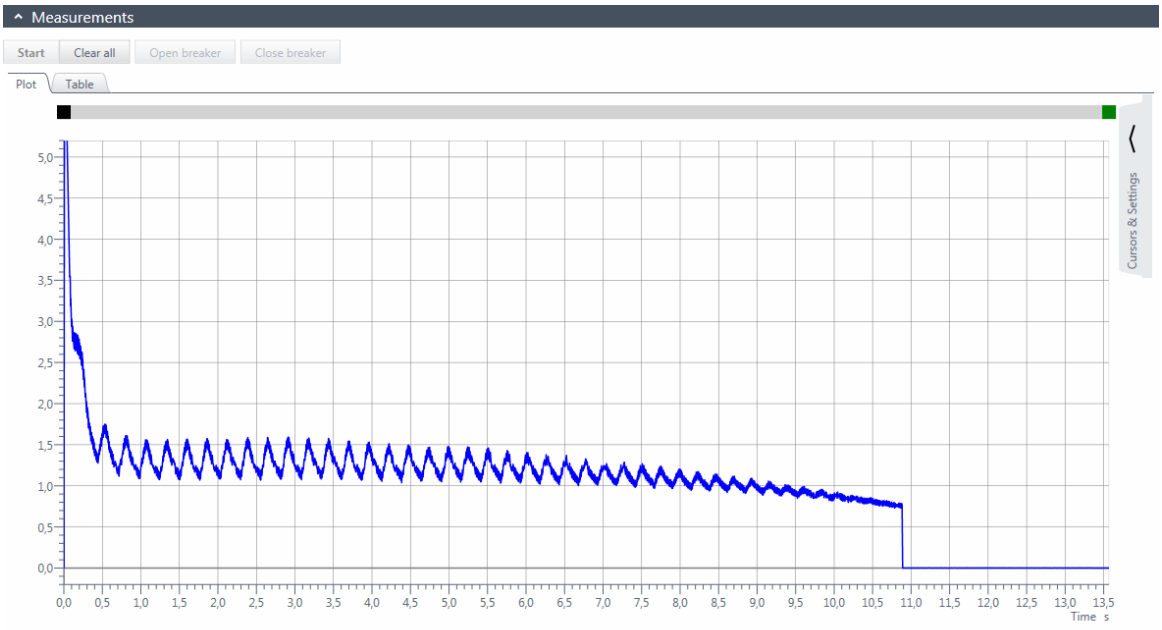


Figure 17-13: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-24: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:

1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green warning light on the *CIBANO 500* front panel is on and the warning symbol on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the safe area.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ► Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect all cables from the circuit breaker.
5. Disconnect all cables from *CIBANO 500*.
6. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
7. Disconnect the mains power cord.
8. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ► Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.1.10 Insulation Resistance test

The Insulation Resistance test is used to import or enter data from an insulation testing device.

Table 17-25: Insulation Resistance test settings

Setting	Description
Test conditions	
Test object temperature	Temperature of the test object
Custom test conditions	Activate the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Calculations	
PI calculation	Calculation of polarization index
Time 1	In the standard PI calculation, the testing device is applied and insulation resistance measurements are taken after 60 seconds (**Time 1**) and 600 seconds (**Time 2**). The polarization index (PI) is calculated as follows: $PI = \frac{R_{600}}{R_{60}}$
Time 2	
DAR calculation	Calculation of dielectric absorption ratio
Time 1	In the standard DAR calculation, the testing device is applied and insulation resistance measurements are taken after 30 seconds (**Time 1**) and 60 seconds (**Time 2**). The dielectric absorption ratio (DAR) is calculated as follows: $DAR = \frac{R_{60}}{R_{30}}$
Time 2	
Correction factors	
Temperature correction	Select the **Temperature correction** check box to activate temperature correction.
Correction temp.	Temperature correction factor

Table 17-26: Insulation Resistance measurement data

Setting	Description
Test data	To import a file containing test data: ► Press **Add** + to browse your computer and add data from a file. To directly import data from a measurement file: ► Open the file on your computer. ► In the file press CTRL+A to mark all content, and then press CTRL+C to copy. ► In *Primary Test Manager* press **Paste from clipboard**. The results may take a few seconds to load.
Measurement	Name or number of the measurement
PI	Polarization index
DAR	Dielectric absorption ratio
Time	Time at which the given values were recorded
Voltage V DC I DC	Voltage and current values recorded at the **Time** specified in the first column

17.1.11 Testing with external power supply

If you use an external power supply (for example, the station battery) for supplying the motor or the coils of the circuit breaker during the test, connect the external power supply to the **V IN** input of *CIBANO 500* and wire the **N** and **BN** sockets as shown in the following figure.

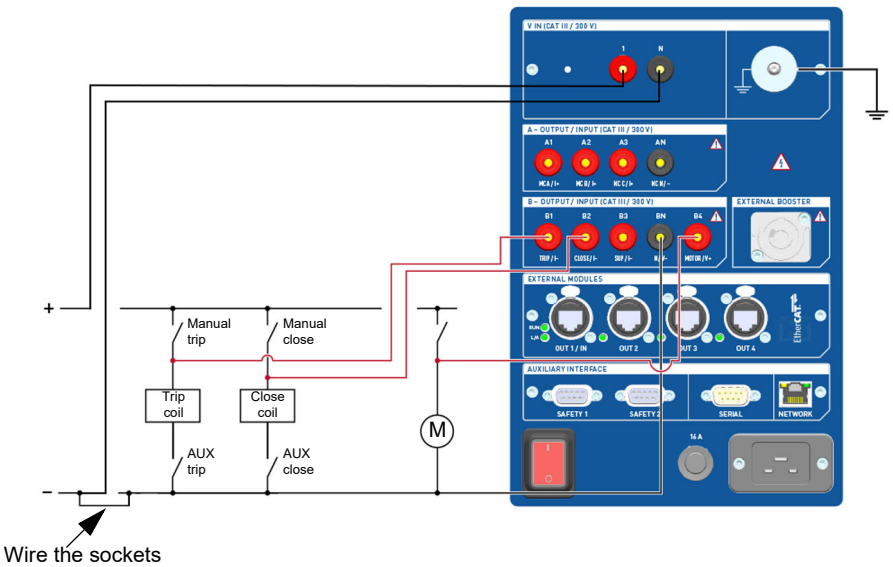


Figure 17-14: Wiring the *CIBANO 500* sockets for testing with external power supply

17.1.12 Continuous power supply

CIBANO 500 provides a continuous power supply on the **B3** socket to supply, for example, circuit breakers with electronic control boards prior to the test and whenever it is needed. After you have connected to *CIBANO 500*, you can configure the continuous power supply in the *Primary Test Manager* status bar.

Note: The continuous power supply is not available for the Contact Resistance test with *CIBANO 500* only (see 17.1.4 "Contact Resistance test" on page 108) and the Minimum Pickup test (see 17.1.8 "Minimum Pickup test" on page 128). If you have activated the continuous power supply and you open one of these tests, *Primary Test Manager* will prompt you to deactivate the continuous power supply before executing the test.

To configure the continuous power supply:

1. In the status bar, click **Edit**.

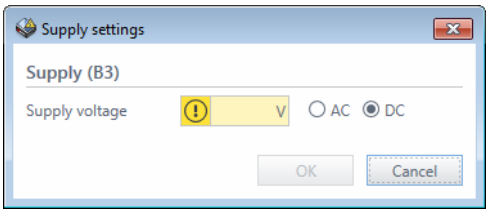


Figure 17-15: **Supply settings** dialog box

2. In the **Supply settings** dialog box, enter the supply voltage you want to use for testing your circuit breaker.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch the **B3** socket and any connected cables after you have activated the continuous power supply.
- ► Always use a strobe light to warn the operating personnel of the possibly dangerous operating condition.

► To activate the continuous power supply, click **ON** in the status bar. After you click **Activate** in the **Activate power supply** dialog box, the configured supply voltage is applied to the **B3** socket, and the red light on the front panel will be flashing indicating possibly dangerous operating condition.

Note: If you have activated the continuous power supply, the coil supply settings are not available because the supply voltage is set by the continuous power supply.

CAUTION

Personal injury due to unexpected operation of the circuit breaker possible

- ► Before deactivating the continuous power supply, open the circuit breaker.

► To deactivate the continuous power supply, click **OFF** in the status bar.

17.2 Testing high-voltage circuit breakers

The high-voltage (HV) circuit breakers are typically tested with the *CB MC2* and *CB TN3* modules in connection with *CIBANO 500*. If you want to test the HV circuit breakers without the *CB MC2* modules, see 17.1 "Testing medium-voltage circuit breakers" on page 103. In this case read both sections carefully and use *Primary Test Manager* as described in 17.1 "Testing medium-voltage circuit breakers" on page 103 but observe also the safety rules and tips and tricks relevant for testing the HV circuit breakers.

17.2.1 Safety precautions in the substation

DANGER

Death or severe injury caused by a lightning discharge

- ► Do not connect the test set to the test object if there is a possibility of a thunderstorm over any part of the system.
- ► Always observe the weather conditions while testing with *CIBANO 500*.

Always observe the following safety rules:

- Disconnect completely.
- Secure against re-connection.
- Verify that the installation is dead.
- Carry out grounding and short-circuiting.
- Provide protection against adjacent live parts.
- Ground the test object at one or more terminals during connecting, testing and disconnecting.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not test with *CIBANO 500* without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

Separate your working area as shown in Figure 1-1: "Example of the separation of the safe and high-voltage test areas" on page 10 into a safe area and a high-voltage test area when a test is running. Set up a suitable barrier and, if applicable, warning lights to protect others from accessing the high-voltage test area and accidentally touching live parts.

If there is a longer distance between the location of *CIBANO 500* and the high-voltage test area (that is, the test object), a second person with an additional **Emergency Stop** button is required.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Never use the *CIBANO 500* test set without a solid connection to ground.
- ► Ground *CIBANO 500* with a cable of at least 6 mm^2 cross-section as close as possible to the operator.

17.2.2 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on*CIBANO 500* by pressing the mains power on/off switch on the side panel. The green warning light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of CIBANO 500" on page 15) flashes for a short time and then extinguishes for approx. one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to CIBANO 500" on page 26.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then do one of the following:

► Click **More** beneath the **Connect** button, and then click **Refresh**.

► Press F5.

Figure 17-16: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 19.1 "Connecting to *CIBANO 500*" on page 243.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new jobs (see 7 "Create new job" on page 46)
- Execute prepared jobs (see 8 "Execute prepared job" on page 65)
- Manage locations, assets, jobs and test reports (see 9 "Manage objects" on page 66)
- Create new manual tests (see 10 "Create new manual tests" on page 73)
- Open existing manual tests (see 11 "Open manual tests" on page 77)
- Generate test reports (see 14 "Generate test reports" on page 83)

The next sections describe the HV circuit breaker tests.

17.2.3 Testing circuit breakers with *CIBANO 500* and the *CB MC2* modules

One or two interrupters per phase

When testing circuit breakers with one or two interrupters per phase you can hook up the *CB MC2* modules to all interrupters at the same time, without reconnecting them during any of the following tests.

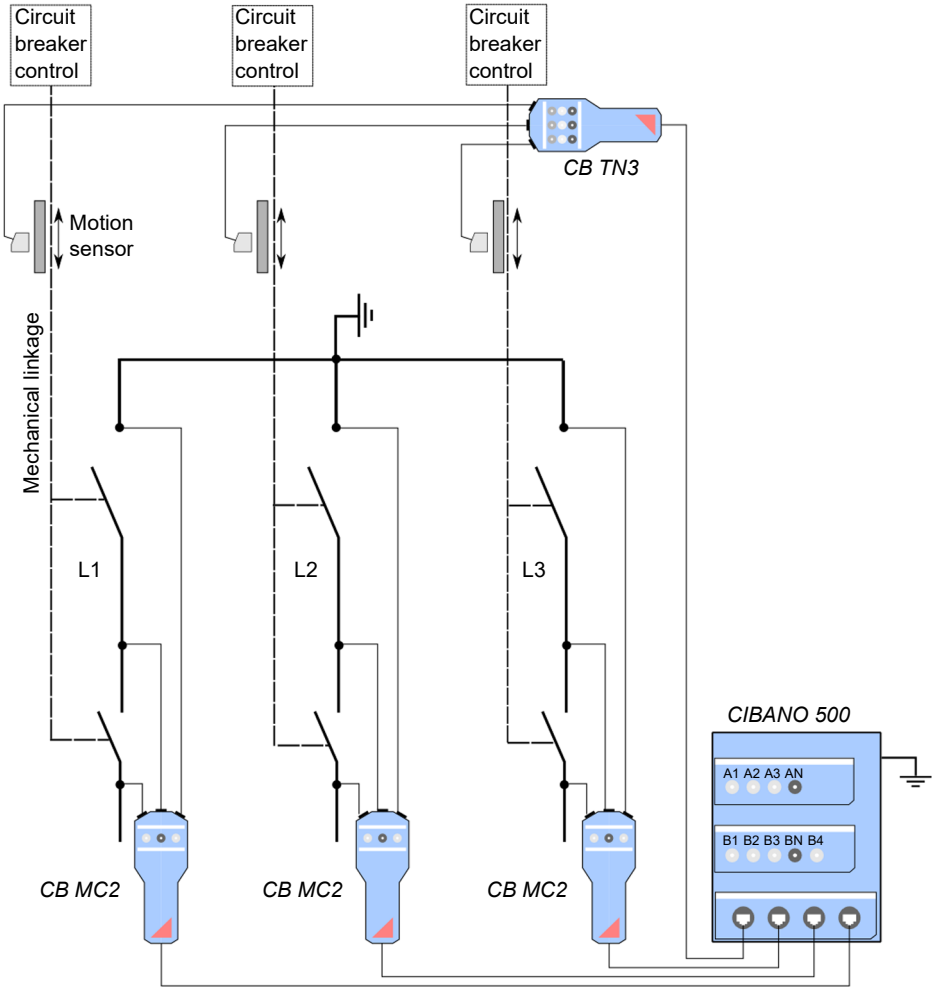


Figure 17-17: High-voltage section of a circuit breaker with two interrupters per phase with directly connected *CB MC2* modules

The *CB MC2* modules can be directly connected to the EtherCAT® module of the main devices or via the EtherCAT® hub as shown in the following figure.

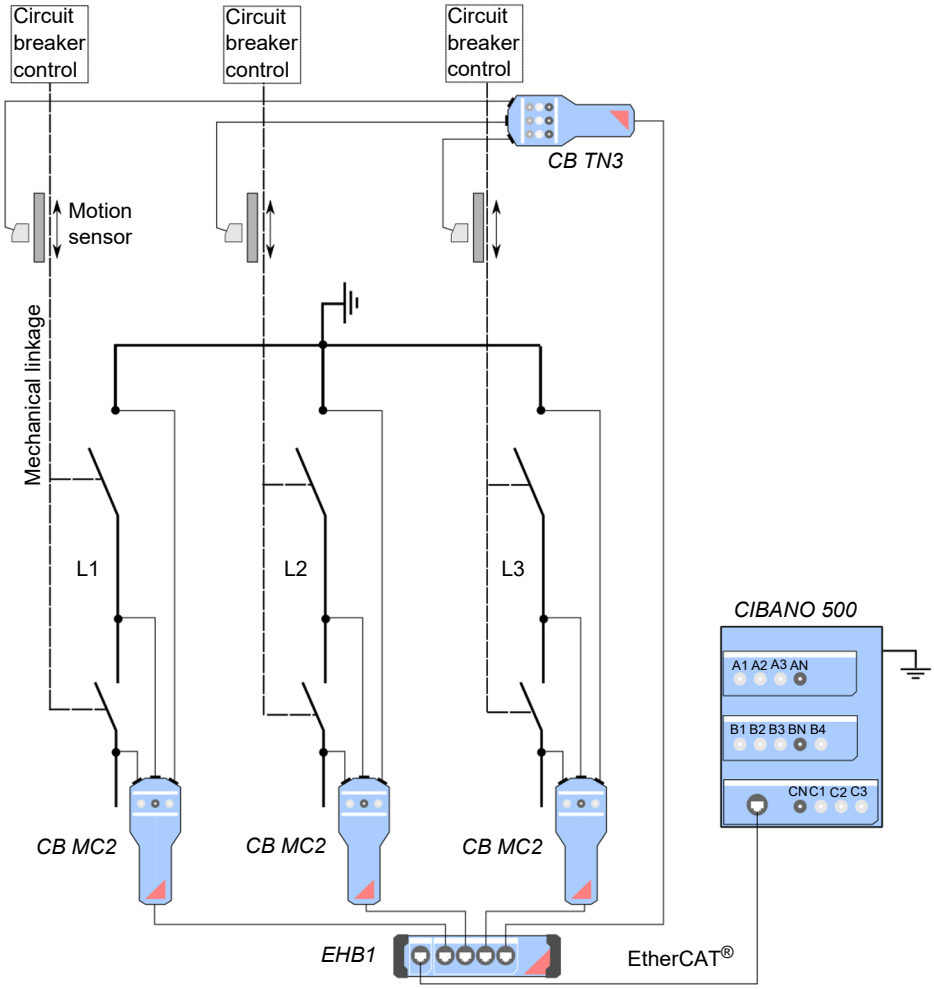


Figure 17-18: High-voltage section of a circuit breaker with two interrupters per phase with the *CB MC2* modules connected via the EtherCAT® hub

Three to six interrupters per phase

If you want to test circuit breakers with more than two interrupters per phase simultaneously phase by phase, connect the EtherCAT® hub to the main device as shown in the following figure.

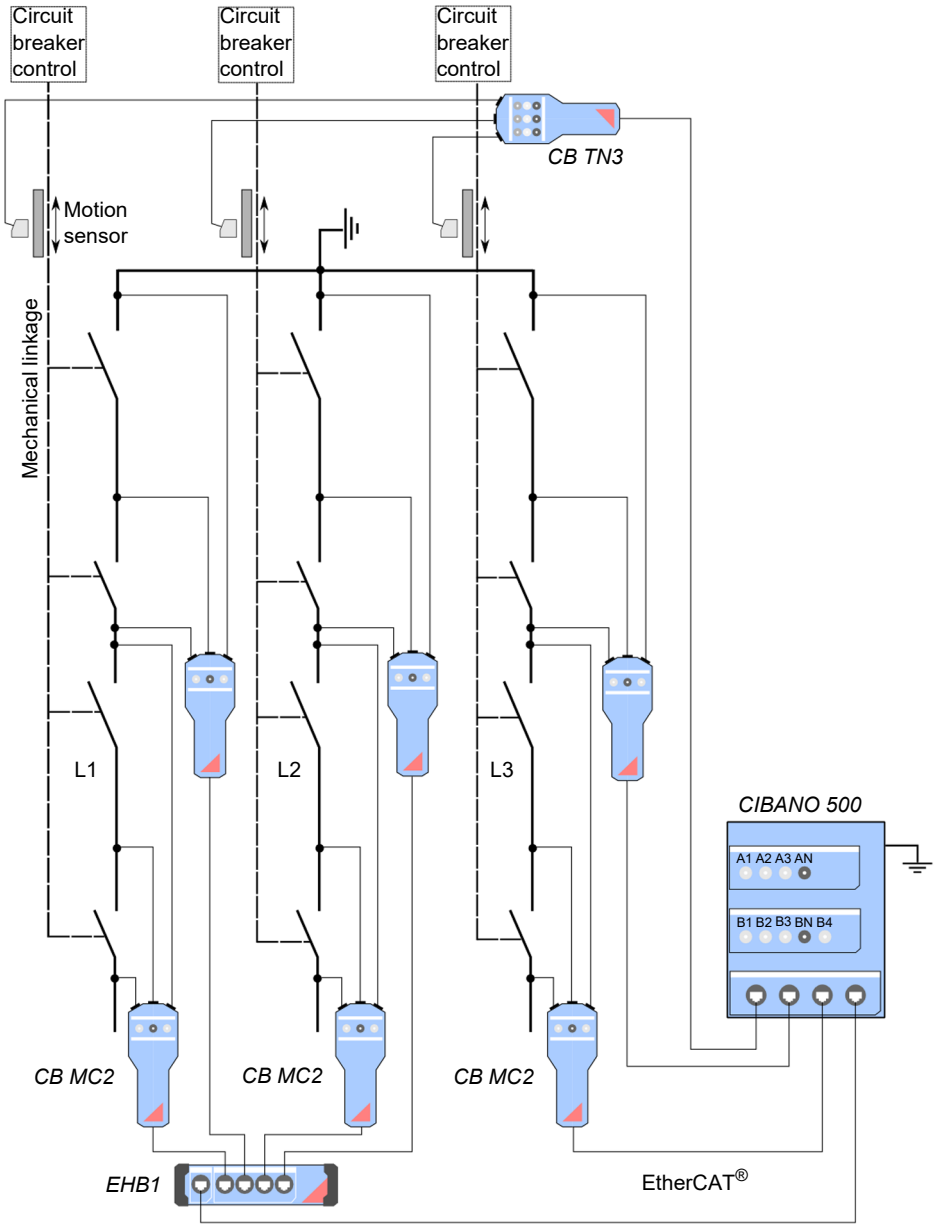


Figure 17-19: Example of simultaneous measurement of the circuit breakers with up to four interrupters per phase

17.2.4 Test group execution

Primary Test Manager provides you with a powerful capability for executing test groups. For information on grouping tests in test groups, see 7.5.2 "Grouping tests" on page 61. After you set the hardware configuration of the test set and the test group settings, you can execute all tests of the test group automatically by clicking the **Start all** button.

To execute a test group:

1. Group tests in a test group (see 7.5.2 "Grouping tests" on page 61).
2. Connect the test object to *CIBANO 500*.
3. In *Primary Test Manager*, open the test group you want to execute.
4. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules. For the hardware configuration options of *CIBANO 500* and the *CB MC2* module, see Table 17-32: "Hardware configuration options of CIBANO 500" on page 154 and Table 17-33: "Hardware configuration options of the CB MC2 module" on page 155.

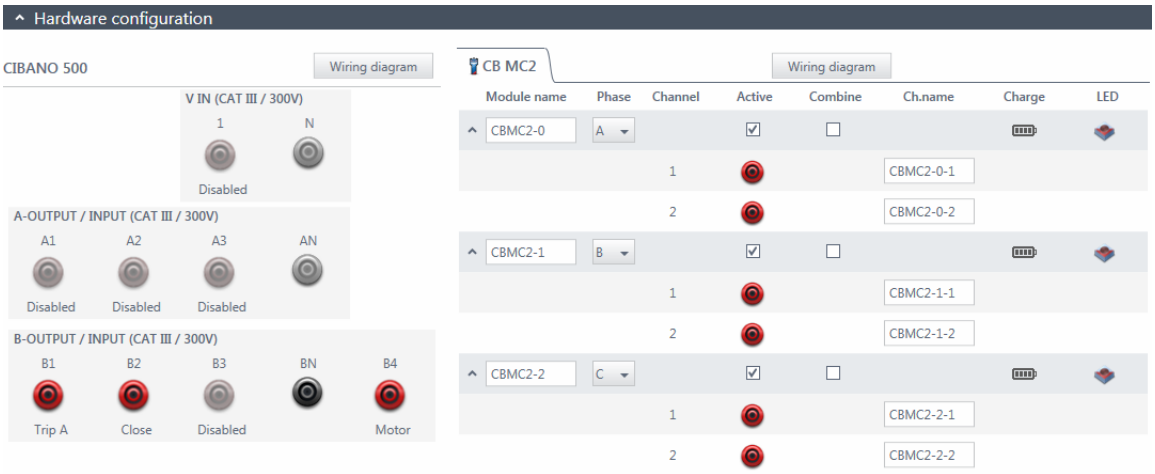


Figure 17-20: Hardware configuration of the test set for a test group

5. In the **Settings and conditions** area, enter the test group settings.

Table 17-27: Test group settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each *CB MC2* current channel[4]
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. In general, we recommend the maximum current of 100 A for maximum accuracy. If during a test the time the circuit breaker is closed should be longer than 1.5 s you might necessarily reduce the test current to drive the current for the whole test duration. Normally, times of 1.5 seconds are however unproblematic.

6. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Test control** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether your *CIBANO 500* is properly wired with the test object.

7. In the **Test control** area, click **Start all**.
   The blue ring on the **Measurement Start/Stop** button is on.

8. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel or click **Stop all** in *Primary Test Manager*.

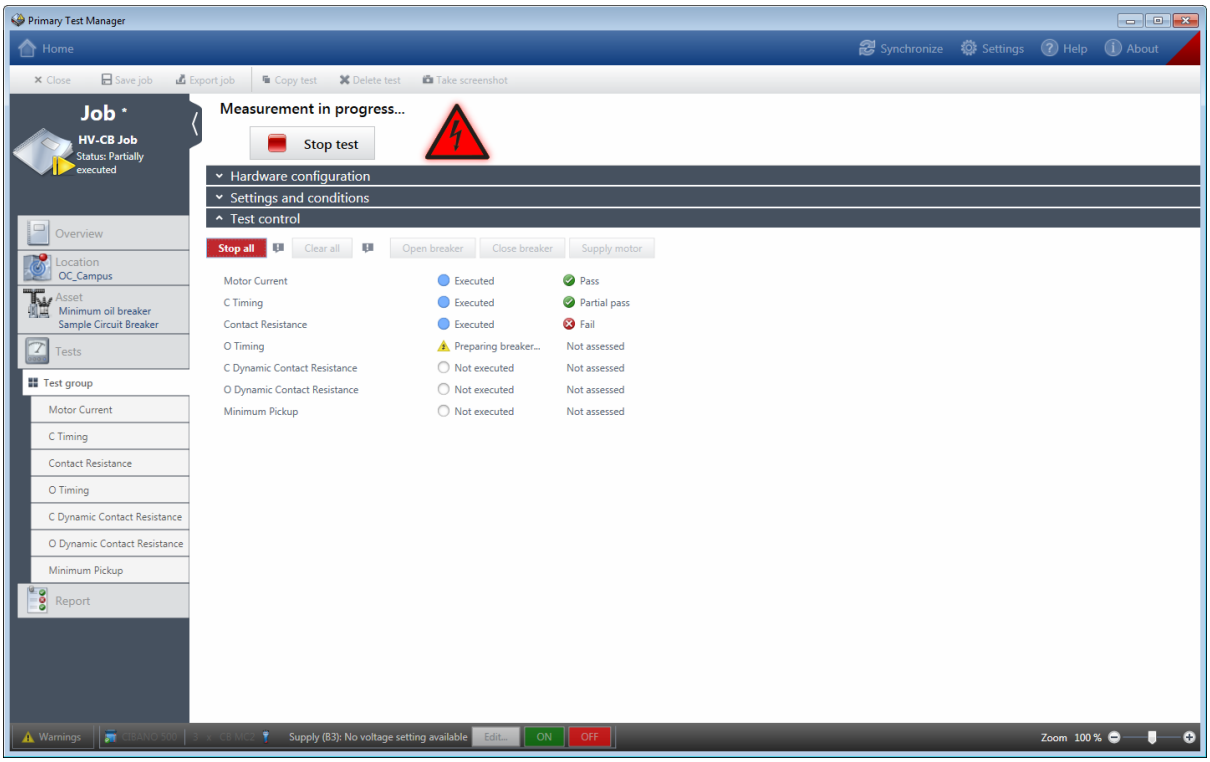


Figure 17-21: Test group execution

9. *Primary Test Manager* executes the tests of the test group sequentially. Before a test is executed, the circuit breaker is brought into the required state, the motor is supplied and the *CB MC2* modules are charged. After a test has been executed, *Primary Test Manager* displays the execution and assessment status if the **Automatic assessment** check box is selected in the tests.

   Note: If a test in the test group is invalid, it will be skipped during the test group execution. You can remove invalid tests before or after executing the test group.

10. After the test execution has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green warning light is on.

17.2.5 Contact Resistance test

The Contact Resistance test measures the static resistance of the circuit breaker's main contacts.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not use external power sources for the circuit breaker's main contacts.
- ► During the test, supply the circuit breaker's main contacts only with *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT® cable.
3. Hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
4. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. If you cannot connect in this way, use the Kelvin clamp as a normal current clamp only for current injection (6 mm connector) and use a separate crocodile clamp for voltage sensing. Then connect the voltage sense closer to the circuit breaker contact than the current clamp.
Because sometimes it is difficult to connect to the center point between two interrupters by using the Kelvin clamp, one pair of Y-clamps is shipped with each *CB MC2* module. With the Y-clamps you can connect alternatively, even cutting through paint with the clamp. In this case connect the voltage sense clamp on the other side of the central housing opposite to the current injection clamp.

5. Repeat steps 2 to 4 for all interrupters you want to test.
6. In *Primary Test Manager*, open the Contact Resistance test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

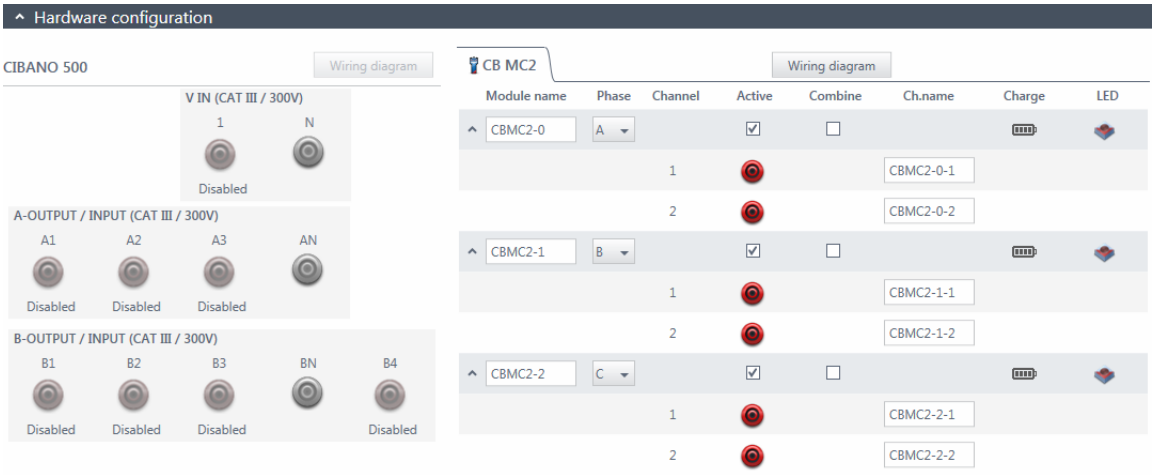


Figure 17-22: Hardware configuration of the Contact Resistance test

Table 17-28: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Disabled
A2	Disabled
A3	Disabled
AN	Common neutral connection for outputs/inputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor or disabled

Table 17-29: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name[1]	Editable name of the *CB MC2* module
Phase	Editable phase assignment of the *CB MC2* module (stored on the device)
Channel	Channel of the *CB MC2* module
Active	Click the socket symbol to activate or deactivate the channel.
Combine	Click the **Combine** check box to combine the channels of the *CB MC2* module. The combined *CB MC2* channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name[1]	Editable name of the *CB MC2* channel
Charge	Indicates the charge status of the *CB MC2* module.
LED	Click the LED symbol to identify the connected *CB MC2* module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

For the basic connection diagram, see Figure 17-5: "Principal scheme of the contact resistance test" on page 109 and 17.2.3 "Testing circuit breakers with CIBANO 500 and the CB MC2 modules" on page 142.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Contact Resistance test.

Table 17-30: Contact Resistance test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively. **Note:** To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency[2]	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each *CB MC2* current channel[4]
Other	

Table 17-30: Contact Resistance test settings (continued)

Setting	Description
Close breaker before test	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Test conditions	
Ambient temperature[5]	Ambient temperature on site

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. In general, we recommend the maximum current of 100 A for maximum accuracy. If during a test the time the circuit breaker is closed should be longer than 1.5 s you might necessarily reduce the test current to drive the current for the whole test duration. Normally, times of 1.5 seconds are however unproblematic.
5. Only for reference in the report, the results are not temperature compensated.

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start all**.
   The blue ring on the **Measurement Start/Stop** button is on.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

5. After the measurements have finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

Table 17-31: Contact Resistance measurement data

Data	Description
Channel	Channel of the *CB MC2* module
I DC	Measured test current
V DC	Measured voltage
R meas	Measured contact resistance
Assessment	Measurement assessment

In case of one interrupter per phase, the groundings on both sides create a current path in parallel to the main contact, and the resistance of this path results in a measurement error. By measuring twice, once with the circuit breaker open and once with the circuit breaker closed, you can compensate the error perfectly by calculating
$R_{CB} = (R_{BsgCBOpen} \times R_{BsgCBClosed})/(R_{BsgCBOpen} - R_{BsgCBClosed})$,
where R_{CB} is the contact resistance of the circuit breaker,
$R_{BsgCBOpen}$ is the resistance of the circuit breaker with both sides grounded, main contacts in open position, and
$R_{BsgCBClosed}$ is the resistance of the circuit breaker with both sides grounded, main contacts in closed position.

If the circuit breaker has an even number of interrupters per phase, the test is typically performed with the circuit breaker grounded on both ends. In this case no compensation is needed because the voltages of the two channels of each *CB MC2* module cancel out each other which results in no current through the ground loop. If only one side of a *CB MC2* module is connected, it is a similar case to the circuit breakers with one interrupter per phase described earlier in this section.

Tips & Tricks: The connection to the center point between two circuit breaker's interrupters can be tricky.If you are not sure whether the connection you have made is good, you can verify the connection as follows. Perform a measurement with only channel 1, then a measurement with channel 2, and finally a measurement with both channels. If the results match you have a perfect center point connection. If the results do not match you either have a bad center connection or the effect of the ground loop, that affects the result only when measuring asymmetrically, is too big.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 183.

17.2.6 Timing test

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence the opening time, closing time, close-open time, and so on are automatically calculated. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 218).

Note: If you have the software license to perform the Dynamic Contact Resistance test proceed with that test as described in 17.2.7 "Dynamic Contact Resistance test" on page 164. The Timing test requires the same amount of work but gives less information.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT® cable.
3. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
4. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.
5. Repeat steps 2 to 4 for all interrupters you want to test.
6. In *Primary Test Manager*, open the Timing test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

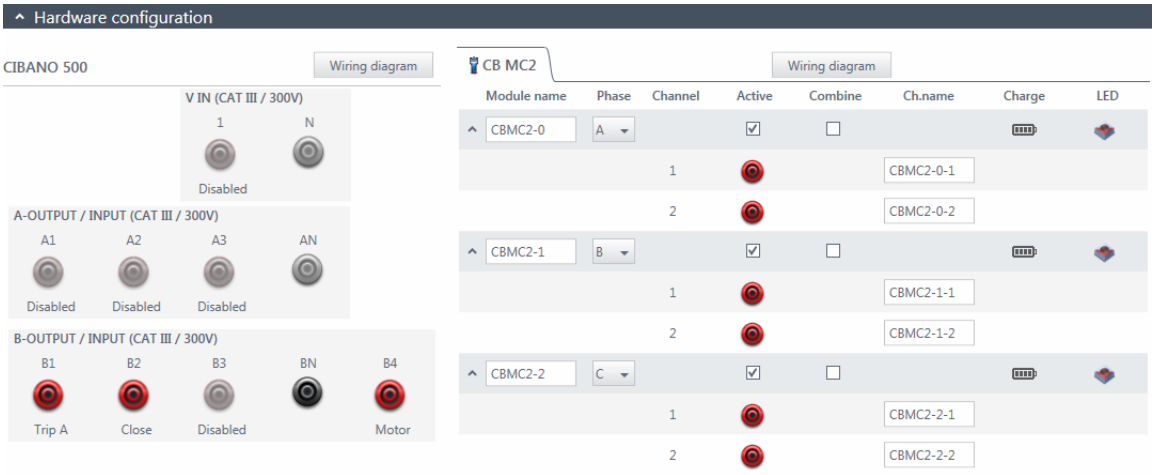


Figure 17-23: Hardware configuration of the Timing test

Table 17-32: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source or disabled		
N	Neutral connection of **V IN**		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, motor A, or disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, motor B, or disabled
		Wet contact (with potential)	
A3	AUX 3	Dry contact (potential-free)	Close C, motor C, or disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group **A**		

Table 17-32: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, I clamp 1, or disabled
B2	Trip B, I clamp 2, close, or disabled
B3	Trip C, I clamp 3, supply, or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor, I clamp 4, or disabled

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket **1** of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the **A** group is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The **A** group can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip *or* three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Timing test.

B-OUTPUT / INPUT (CAT III / 300 V)

The **B** group is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 185). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-33: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name[1]	Editable name of the *CB MC2* module
Phase	Editable phase assignment of the *CB MC2* module (stored on the device)
Channel	Channel of the *CB MC2* module
Active	Click the socket symbol to activate or deactivate the channel.

Table 17-33: Hardware configuration options of the *CB MC2* module (continued)

CB MC2	Option
Combine	Click the **Combine** check box to combine the channels of the *CB MC2* module. The combined *CB MC2* channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name[1]	Editable name of the *CB MC2* channel
Charge	Indicates the charge status of the *CB MC2* module.
LED	Click the LED symbol to identify the connected *CB MC2* module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

8. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

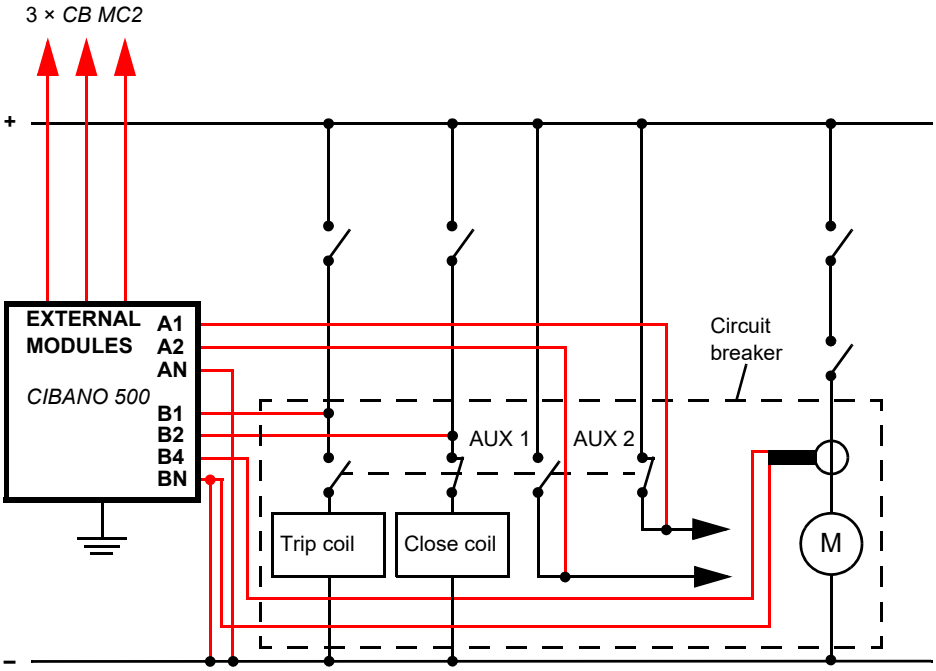


Figure 17-24: Typical measurement setup for the Timing test

For the circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**. In general, the motor of the HV circuit breakers remains connected to the station battery throughout the test and a current clamp connected to **BN** and **B4** is used to record the motor current.

Note: Connect the current clamp neutral directly to *CIBANO 500* and not to the other end of the neutral cable to avoid measurement errors due to the voltage drop on the cable. Alternatively you can supply the motor from *CIBANO 500* if you want or no station battery is available.

WARNING

Death or severe injury caused by high voltage or current possible

- ► If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ► Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-34: Timing test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively. **Note:** To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency[2]	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each *CB MC2* current channel[4]
Measure PIR[2]	Select the **Measure PIR** check box to measure timing of the pre-insertion resistors.
C-O threshold	Resistance threshold to detect whether the main contact is open or closed. *Primary Test Manager* interprets the contact as open if the contact resistance is over the C-O threshold and vice versa.
Other	
Close breaker before test[5]	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate[6]
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Current clamp settings[7]	

Table 17-34: Timing test settings (continued)

Setting	Description
Channel	**B** group I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Sequence	
O	Perform an open sequence
C	Perform a close sequence
OC[8]	Perform a reclose sequence
CO[8]	Perform a trip-free sequence
O-CO[8]	Perform an O-CO sequence
CO-CO	Perform a CO-CO sequence
O-CO-CO	Perform an O-CO-CO sequence

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
5. The **Close breaker before test** check box is only active if the test sequence begins with the open command.
6. We recommend 10 kHz to constrain the amount of created data. Higher sample rates are needed for special tests only.
7. Only available if a current clamp is configured. The channel value displayed refers to the **B** group of the I/O sockets on the *CIBANO 500* side panel. The **B1**…**B4** sockets can be configured as **I clamp 1**…**I clamp 4** respectively.
8. See Table 17-35: "Timing test sequences" on page 160.

The following table explains the sequences of the Timing test.

Table 17-35: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.

Table 17-35: Timing test sequences (continued)

Sequence	Action
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).
CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).
O-CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.

4. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.
   The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-36: Operating times

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation[1]
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation[1]
Closing time	Contact closing time of C, CO and O-CO operation[1]
Closing sync.	Closing synchronization time of C, CO and O-CO operation[1]
Reclosing time	Contact reclosing time of OC operation[1]
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation[1]
Close-open time 1	Contact close-open time of CO and O-CO operation[1]
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation[1]
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-37: Auxiliary contact characteristics[1]

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-38: Main contact characteristics[1]

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time[2]	Duration of the main contact bounce
Bounce count[2]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences
2. Not available if the **Measure PIR** check box is selected

Table 17-39: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 183.

17.2.7 Dynamic Contact Resistance test

The Dynamic Contact Resistance test measures the resistance of the circuit breaker's main contacts during opening or closing. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 218).

Note: To perform the Dynamic Contact Resistance test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT® cable.
2. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
3. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.
4. Repeat steps 1 to 3 for all interrupters you want to test.
5. Make sure that all cable connectors are clean and dry before being tightly connected.
6. In *Primary Test Manager*, open the Dynamic Contact Resistance test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

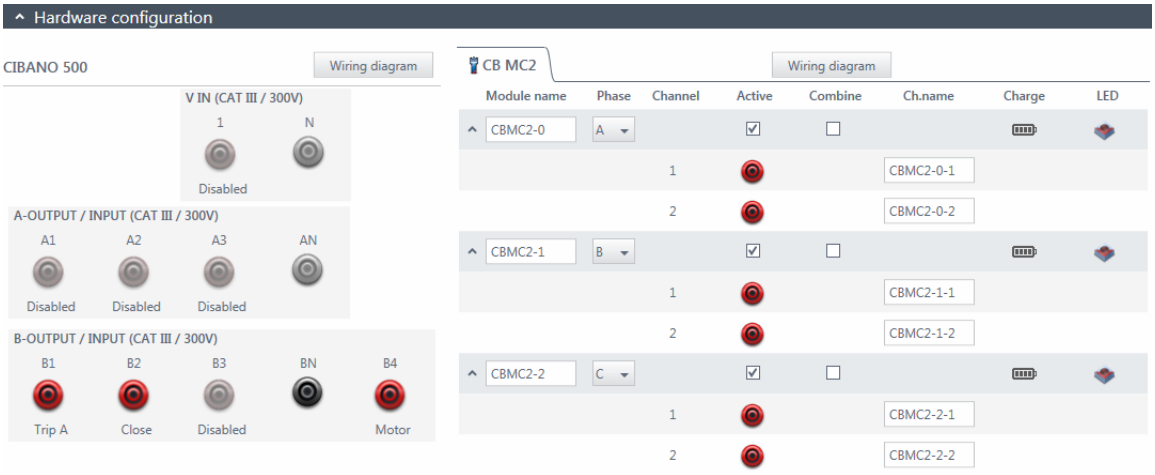


Figure 17-25: Hardware configuration of the Dynamic Contact Resistance test

Table 17-40: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source or disabled		
N	Neutral connection of **V IN**		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, motor A, or disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, motor B, or disabled
		Wet contact (with potential)	
A3	AUX 3	Dry contact (potential-free)	Close C, motor C, or disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group **A**		

Table 17-40: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, I clamp 1, or disabled
B2	Trip B, I clamp 2, close, or disabled
B3	Trip C, I clamp 3, supply, or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor, I clamp 4, or disabled

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket **1** of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the **A** group is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The **A** group can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip *or* three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Dynamic Contact Resistance test. The other tests like CO or OC with the trip and close signal applied simultaneously are then performed with different wiring.

B-OUTPUT / INPUT (CAT III / 300 V)

The **B** group is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 185). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-41: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name[1]	Editable name of the *CB MC2* module
Phase	Editable phase assignment of the *CB MC2* module (stored on the device)
Channel	Channel of the *CB MC2* module
Active	Click the socket symbol to activate or deactivate the channel.

Table 17-41: Hardware configuration options of the *CB MC2* module (continued)

CB MC2	Option
Combine	Click the **Combine** check box to combine the channels of the *CB MC2* module. The combined *CB MC2* channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name[1]	Editable name of the *CB MC2* channel
Charge	Indicates the charge status of the *CB MC2* module.
LED	Click the LED symbol to identify the connected *CB MC2* module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

8. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

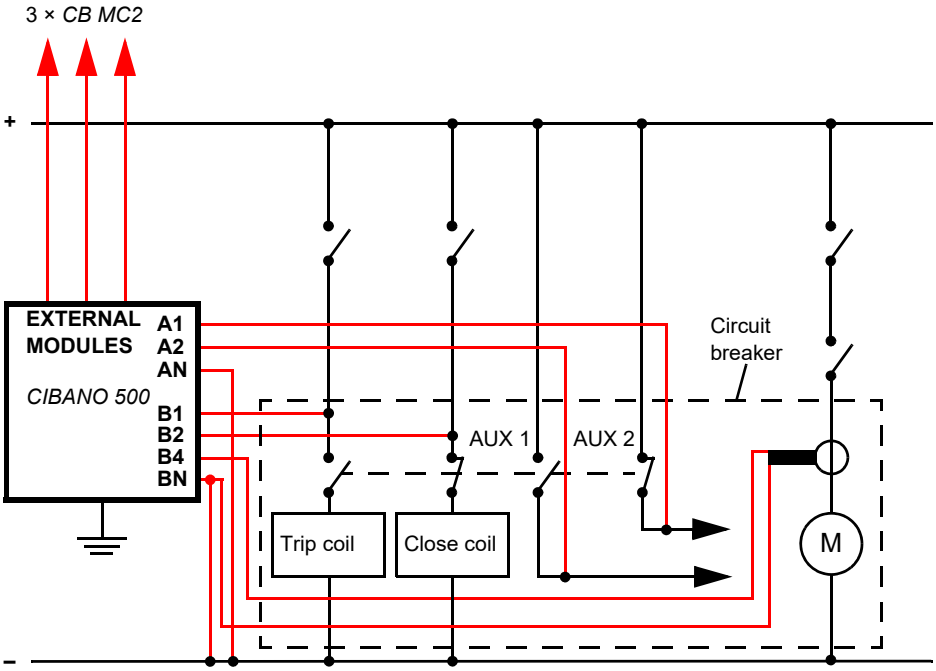


Figure 17-26: Typical measurement setup for the Dynamic Contact Resistance test

For circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**. The HV circuit breaker's motor remains generally connected to the station battery throughout the test and a current clamp connected to **BN** and **B4** is used to record the motor current.

Note: Connect the current clamp neutral directly to *CIBANO 500* and not to the other end of the neutral cable to avoid measurement errors due to the voltage drop on the cable. Alternatively you can supply the motor from *CIBANO 500* if you want or no station battery is available.

Circuit breakers with three drives are either tested phase by phase (see 17.2.3 "Testing circuit breakers with CIBANO 500 and the CB MC2 modules" on page 142) or you can connect the three trip and close signals together. If you want to record the supply current for three coils simultaneously you can configure the sockets by clicking them.

WARNING

Death or severe injury caused by high voltage or current possible

- ► If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ► Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Dynamic Contact Resistance test.

Table 17-42: Dynamic Contact Resistance test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively. **Note:** To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency[2]	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each *CB MC2* current channel[4]
Measure PIR[2]	Select the **Measure PIR** check box to measure timing of the pre-insertion resistors.
C-O threshold	Resistance threshold to detect whether the main contact is open or closed. *Primary Test Manager* interprets the contact as open if the contact resistance is over the C-O threshold and vice versa.
Other	
Close breaker before test[5]	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate[6]
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Current clamp settings[7]	

Table 17-42: Dynamic Contact Resistance test settings (continued)

Setting	Description
Channel	**B** group I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[2,3]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Sequence	
O	Perform an open sequence
C	Perform a close sequence
OC[8]	Perform a reclose sequence
CO[8]	Perform a trip-free sequence
O-CO[8]	Perform an O-CO sequence
CO-CO	Perform a CO-CO sequence
O-CO-CO	Perform an O-CO-CO sequence

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
5. The **Close breaker before test** check box is only active if the test sequence begins with the open command.
6. We recommend 10 kHz to constrain the amount of created data. Higher sample rates are needed for special tests only.
7. Only available if a current clamp is configured. The channel value displayed refers to the **B** group of the I/O sockets on the *CIBANO 500* side panel. The **B1**…**B4** sockets can be configured as **I clamp 1**…**I clamp 4** respectively.
8. See Table 17-43: "Dynamic Contact Resistance test sequences" on page 171.

The following table explains the sequences of the Dynamic Contact Resistance test.

Table 17-43: Dynamic Contact Resistance test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.

Table 17-43: Dynamic Contact Resistance test sequences (continued)

Sequence	Action
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).
CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).
O-CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.

4. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.
   The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-44: Operating times

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation[1]
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation[1]
Closing time	Contact closing time of C, CO and O-CO operation[1]
Closing sync.	Closing synchronization time of C, CO and O-CO operation[1]
Reclosing time	Contact reclosing time of OC operation[1]
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation[1]
Close-open time 1	Contact close-open time of CO and O-CO operation[1]
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation[1]
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-45: Auxiliary contact characteristics[1]

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-46: Main contact characteristics[1]

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time[2]	Duration of the main contact bounce
Bounce count[2]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences
2. Not available if the **Measure PIR** check box is selected

Table 17-47: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 183.

17.2.8 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
   Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

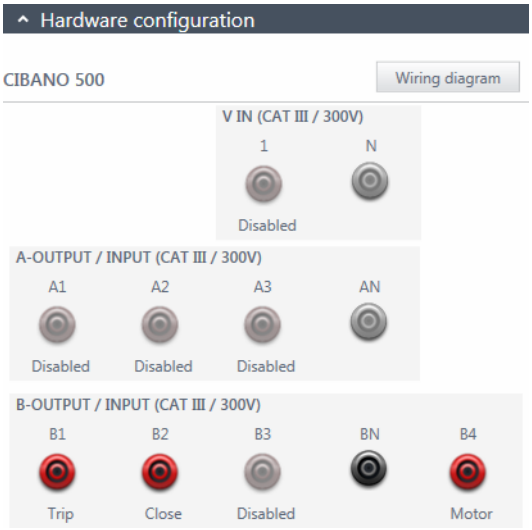


Figure 17-27: Hardware configuration of the Minimum Pickup test

Table 17-48: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)[1]	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled
A3	Motor C or disabled
AN	Common neutral connection for outputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Common neutral connection for outputs in group **B**
B4	Motor or disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.

3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-49: Minimum Pickup test settings

Setting	Description
Coil supply	
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Supply during coil supply	
Enable	Select the **Enable** check box to supply voltage on the **B3** socket during test execution.[3]
Supply voltage	Voltage supplied on the **B3** socket (same as the coil supply voltage)

Table 17-49: Minimum Pickup test settings (continued)

Setting	Description
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Command impulse duration	Duration of the command pulse of the automated test sequence
Pause between impulses	Time interval between impulses of the automated test sequence
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[2,4]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.
4. Only available if *CIBANO 500* is selected as source

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.
4. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

   Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

Table 17-50: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

In case of three different trip coils, the trip coils can trip at different voltages. After the last pole has tripped the test will stop and show the worst case result.

Note: If there is an active discordance protection in place you must deactivate it for this test to avoid tripping of the other phases due to the discordance protection instead of the minimum pickup test.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 183.

17.2.9 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "–" or neutral contact of the motor.

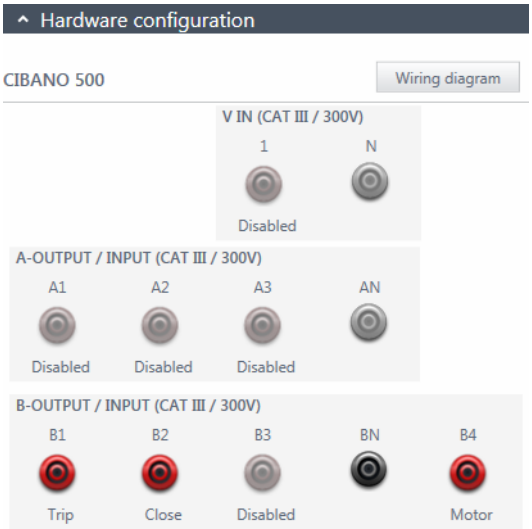


Figure 17-28: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-51: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled
A3	Motor C or disabled
AN	Common neutral connection for outputs/inputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor or disabled

4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect *CIBANO 500* to the motor of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

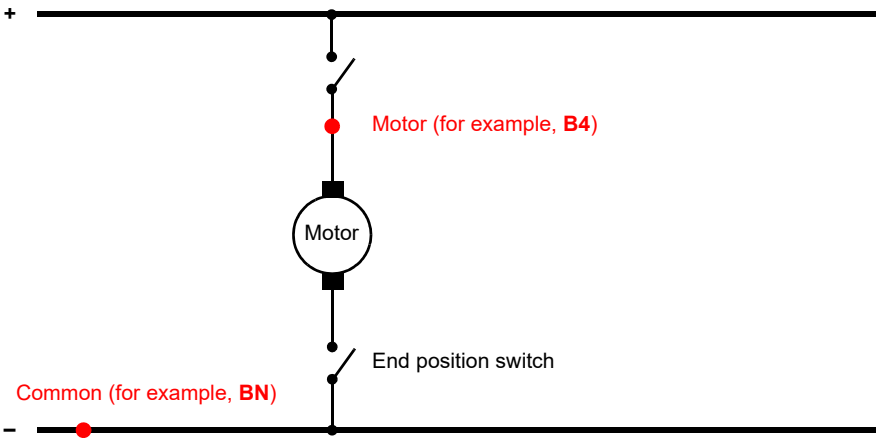


Figure 17-29: Connecting *CIBANO 500* to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-52: Motor Current test settings

Setting	Description
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[1,2]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[1]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils externally.
Supply setting[3]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[1,2]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[1]	Coil supply frequency (AC only)
Other	
Sample rate	Measurement sample rate

1. Data taken from the nameplate
2. Only available if *CIBANO 500* is selected as source
3. Only available in the guided test workflow

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.

5. After the charging process has finished, *CIBANO 500* stops the measurement automatically.
   The lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

The following figure shows an example of the Motor Current test graphical results.

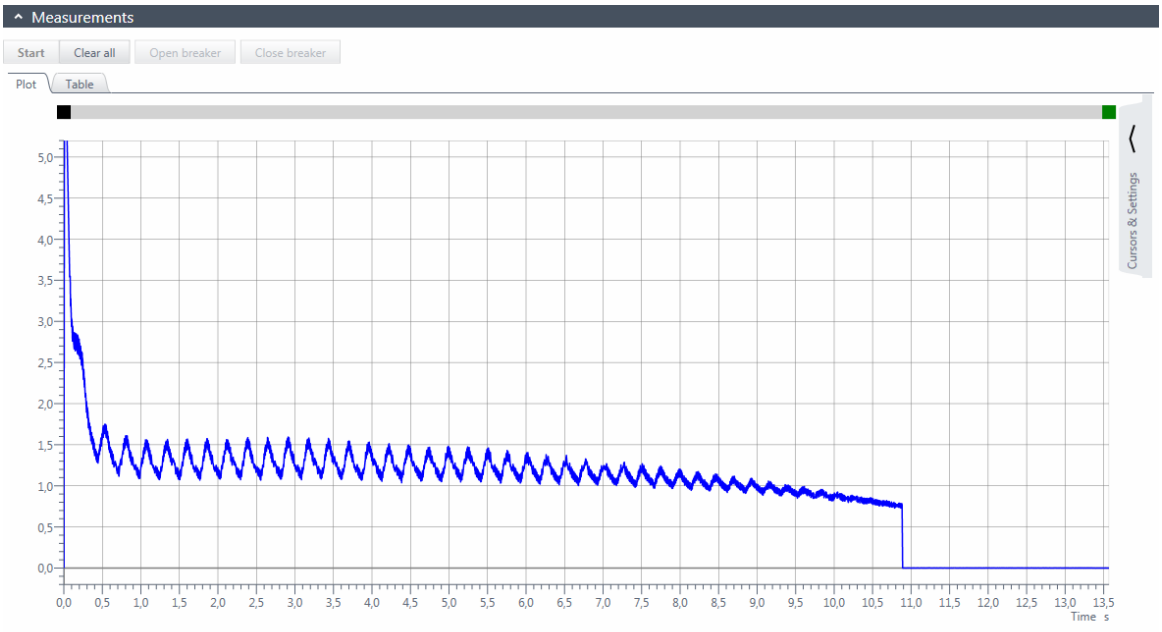


Figure 17-30: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-53: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:

1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green warning light on the *CIBANO 500* front panel is on and the warning symbol on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the safe area.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ► Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not proceed without grounding the test object's terminals.
- ► Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ► Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.2.10 Testing with external power supply

If you use an external power supply (for example, the station battery) for supplying the motor or the coils of the circuit breaker during the test, connect the external power supply to the **V IN** input of *CIBANO 500* and wire the **N** and **BN** sockets as shown in the following figure.

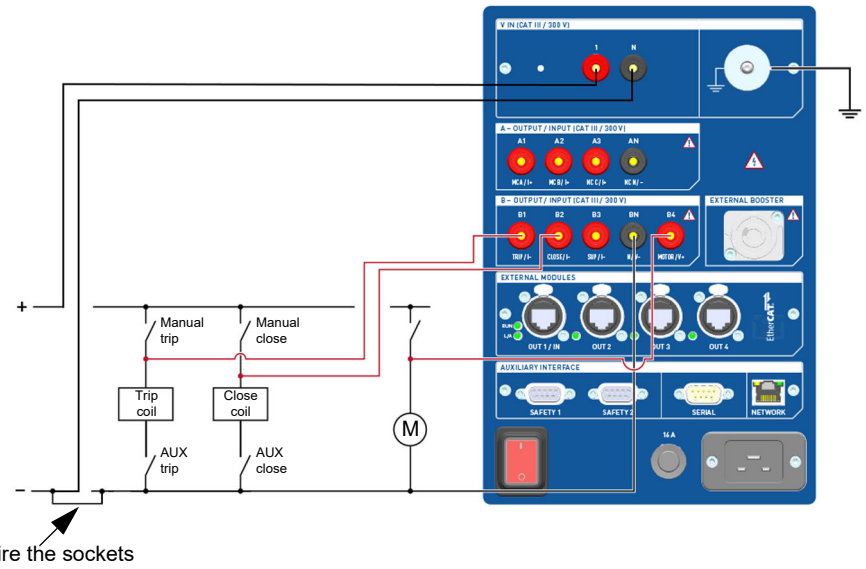


Figure 17-31: Wiring the *CIBANO 500* sockets for testing with external power supply

17.2.11 Continuous power supply

CIBANO 500 provides a continuous power supply on the **B3** socket to supply, for example, hybrid circuit breakers prior the test and whenever it is needed. After you have connected to *CIBANO 500*, you can configure the continuous power supply in the *Primary Test Manager* status bar.

Note: The continuous power supply is not available for the Minimum Pickup test (see 17.2.8 "Minimum Pickup test" on page 175). If you have activated the continuous power supply and you open the Minimum Pickup test, *Primary Test Manager* will prompt you to deactivate the continuous power supply before executing the test.

To configure the continuous power supply:

1. In the status bar, click **Edit**.

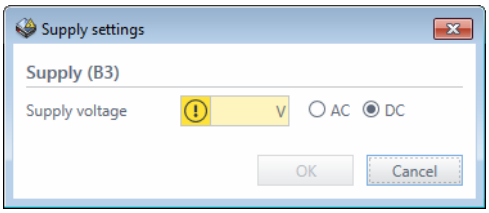


Figure 17-32: **Supply settings** dialog box

2. In the **Supply settings** dialog box, enter the supply voltage you want to use for testing your circuit breaker.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch the **B3** socket and any connected cables after you have activated the continuous power supply.
- ► Always use a strobe light to warn the operating personnel of the possibly dangerous operating condition.

► To activate the continuous power supply, click **ON** in the status bar. After you click **Activate** in the **Activate power supply** dialog box, the configured supply voltage is applied the **B3** socket, and the red light on the front panel will be flashing indicating possibly dangerous operating condition.

Note: If you have activated the continuous power supply, the coil supply settings are not available because the supply voltage is set by the continuous power supply.

CAUTION

Personal injury due to unexpected operation of the circuit breaker possible

- ► Before deactivating the continuous power supply, open the circuit breaker.

► To deactivate the continuous power supply, click **OFF** in the status bar.

17.3 Testing gas insulated switchgears with both sides grounded

CIBANO 500 in connection with *Primary Test Manager* supports testing of gas insulated switchgears (GIS) with both sides grounded. This section describes the following GIS tests:

- Timing (GIS) (see 17.3.4 "Timing (GIS) test" on page 193)
- Minimum Pickup (see 17.3.5 "Minimum Pickup test" on page 203)
- Motor Current (see 17.3.6 "Motor Current test" on page 207)

For testing of single-side grounded gas insulated switchgears, proceed as described in 17.1 "Testing medium-voltage circuit breakers" on page 103 or 17.2 "Testing high-voltage circuit breakers" on page 140.

17.3.1 Safety precautions in the substation

DANGER

Death or severe injury caused by a lightning discharge

► Do not connect the test set to the test object if there is a possibility of a thunderstorm over any part of the system.

► Always observe the weather conditions while testing with *CIBANO 500*.

Always observe the following safety rules:

- Disconnect completely.
- Secure against re-connection.
- Verify that the installation is dead.
- Carry out grounding and short-circuiting.
- Provide protection against adjacent live parts.
- Ground the test object at one or more terminals during connecting, testing and disconnecting.

WARNING

Death or severe injury caused by high voltage or current possible

► Do not test with *CIBANO 500* without grounding the circuit breaker.

► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

Separate your working area as shown in Figure 1-1: "Example of the separation of the safe and high-voltage test areas" on page 10 into a safe area and a dangerous area when a test is running. Set up a suitable barrier and, if applicable, warning lights to protect others from accessing the dangerous area and accidentally touching live parts.

If there is a longer distance between the location of *CIBANO 500* and the dangerous area (that is, the test object), a second person with an additional **Emergency Stop** button is required.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Never use the *CIBANO 500* test set without a solid connection to ground.
- ► Ground *CIBANO 500* with a cable of at least 6 mm^2 cross-section as close as possible to the operator.

17.3.2 Gas insulated switchgears

In order to do safe maintenance work, grounding switches are commonly incorporated into gas insulated switchgears (GIS). They connect the conductor to ground and prevent any parts to be charged with high voltages as result of capacitive coupling.

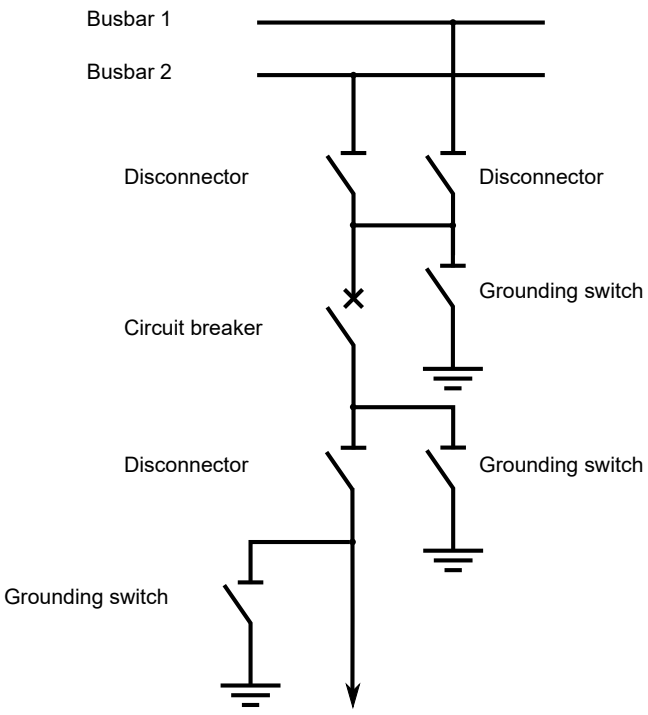


Figure 17-33: Single-line diagram of a GIS with enough grounding switches – safe and comfortable solution for circuit breaker maintenance

The more grounding switches and disconnectors are incorporated, the safer is the maintenance work on the circuit breaker.

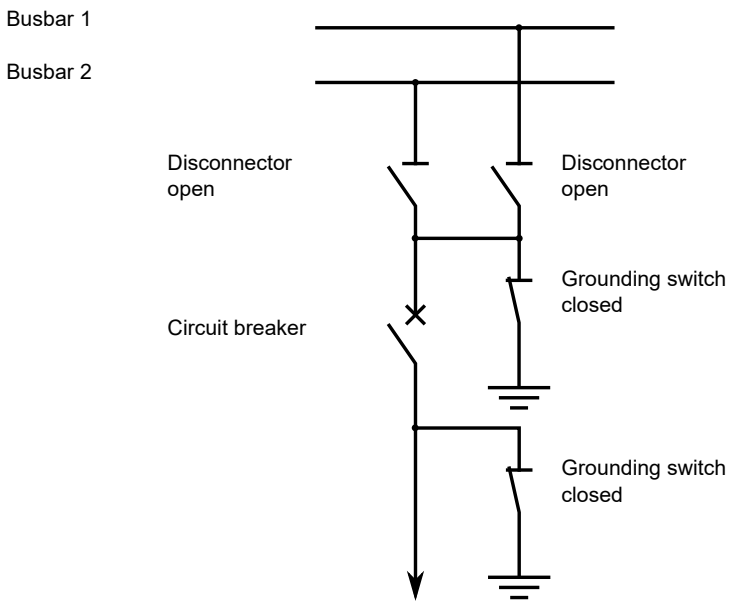


Figure 17-34: Single-line diagram of a GIS with a minimum set of grounding switches and disconnectors – unsafe to open grounding switches during circuit breaker maintenance

Because the grounding switch connects the line conductor to the ground connection, the line conductor can usually be accessed from outside of the GIS.

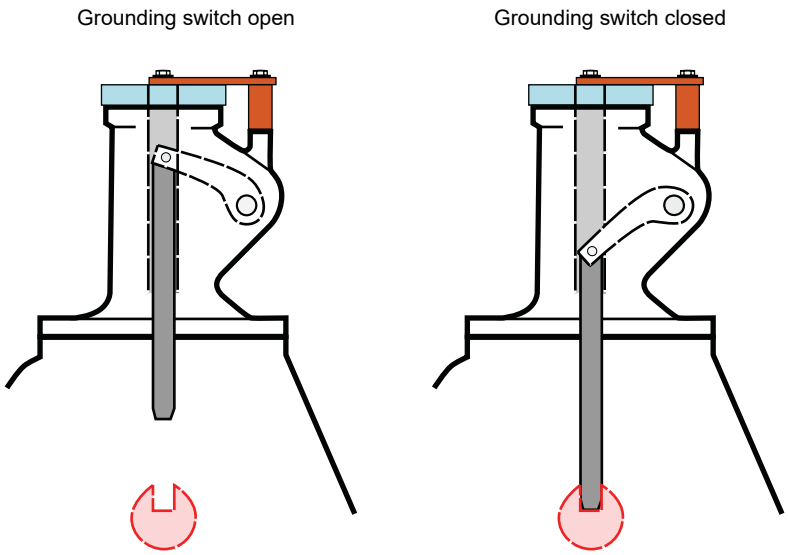


Figure 17-35: How a grounding switch works

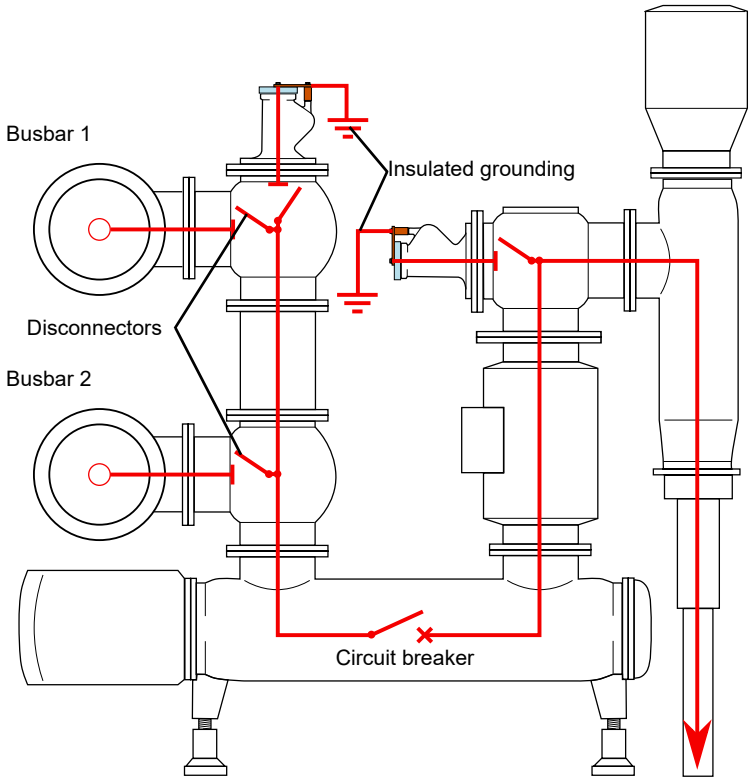


Figure 17-36: GIS with two insulated grounding switches

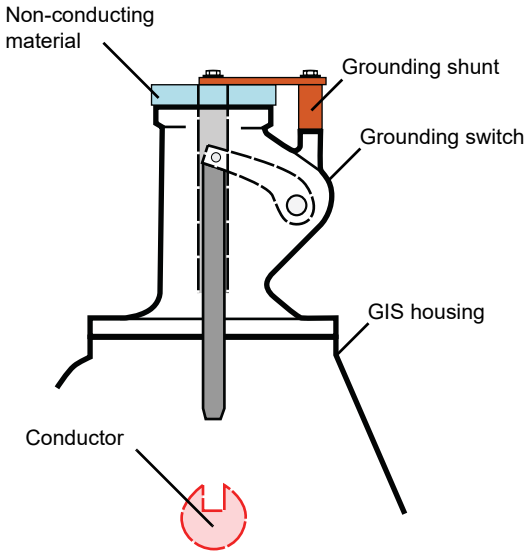


Figure 17-37: Grounding switch components

If the grounding switch is closed, the line conductor within the GIS is connected via a grounding shunt on top of the grounding switch with the GIS housing which has ground potential.

Grounding switches can be insulated or non-insulated. On insulated grounding switches the connection between the line conductor and the ground connection (housing of the GIS) can be removed.

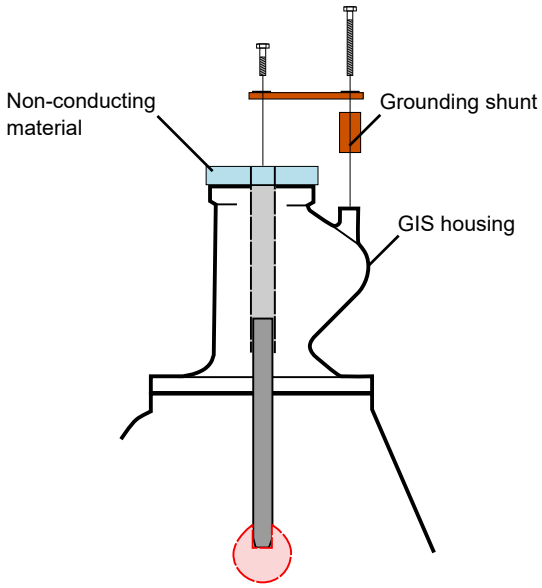


Figure 17-38: Insulated grounding switch

17.3.3 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on *CIBANO 500* by pressing the mains power on/off switch on the side panel. The green warning light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of CIBANO 500" on page 15) flashes for a short time and then extinguishes for approx. one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to CIBANO 500" on page 26.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then do one of the following:

► Click **More** beneath the **Connect** button, and then click **Refresh**.

► Press F5.

Figure 17-39: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 19.1 "Connecting to *CIBANO 500*" on page 243.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new jobs (see 7 "Create new job" on page 46)
- Execute prepared jobs (see 8 "Execute prepared job" on page 65)
- Manage locations, assets, jobs and test reports (see 9 "Manage objects" on page 66)
- Create new manual tests (see 10 "Create new manual tests" on page 73)
- Open existing manual tests (see 11 "Open manual tests" on page 77)
- Generate test reports (see 14 "Generate test reports" on page 83)

The next sections describe the tests of gas insulated switchgears with both sides grounded.

17.3.4 Timing (GIS) test

The Timing (GIS) test measures the contact timing of the circuit breaker. Depending on the selected sequence the opening time, closing time, close-open time, and so on are automatically calculated. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 218).

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

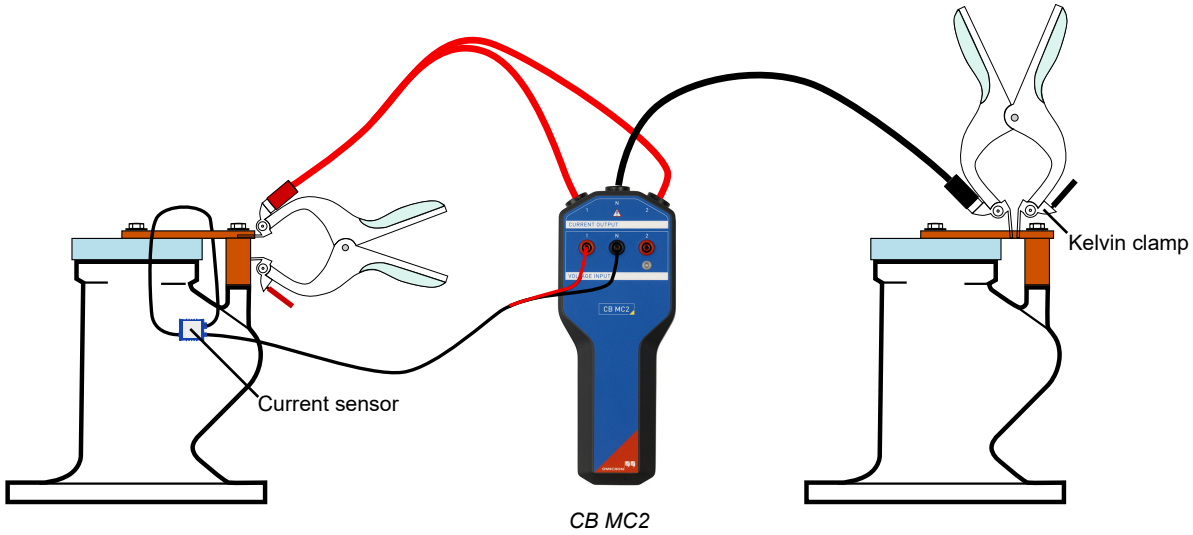


Figure 17-40: Connecting the *CB MC2* module to a both-side grounded GIS

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT® cable.

3. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the interrupter of the circuit breaker.
4. Connect the *CB MC2* current channels to the main contact of the circuit breaker with the delivered cables and clamps.
5. Connect the current sensor to channel 1 of the *CB MC2* voltage channel and put it around the insulated ground connection point.
6. Repeat steps 2 to 4 for all phases you want to test.
7. In *Primary Test Manager*, open the Timing (GIS) test.
8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

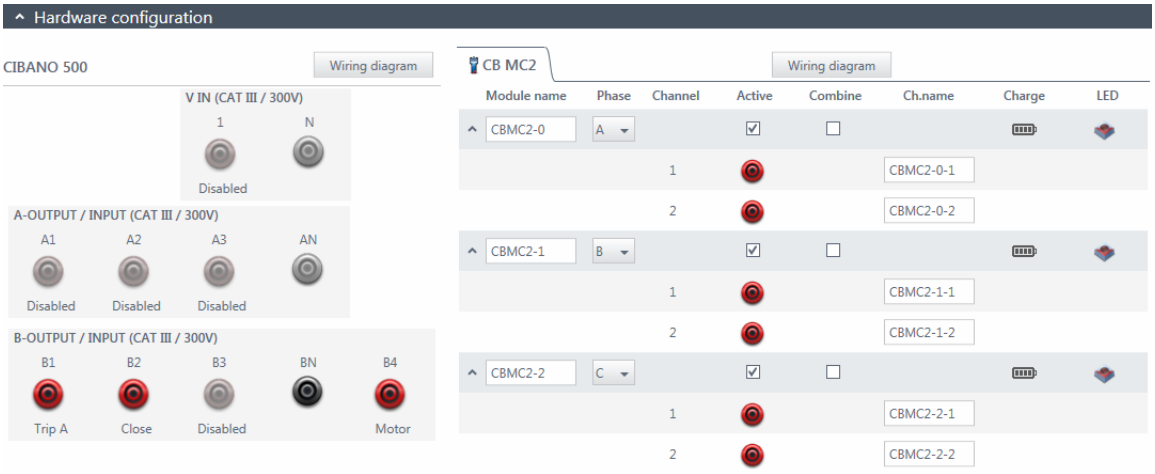


Figure 17-41: Hardware configuration of the Timing (GIS) test

Table 17-54: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source or disabled		
N	Neutral connection of **V IN**		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, motor A, or disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, motor B, or disabled
		Wet contact (with potential)	

Table 17-54: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option		
A3	AUX 3	Dry contact (potential-free)	Close C, motor C, or disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group **A**		
B-OUTPUT / INPUT (CAT III / 300 V)			
B1	Trip A, I clamp 1, or disabled		
B2	Trip B, I clamp 2, close, or disabled		
B3	Trip C, I clamp 3, supply, or disabled		
BN	Neutral connection of outputs in group **B**		
B4	Motor, I clamp 4, or disabled		

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket **1** of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the **A** group is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The **A** group can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip *or* three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Timing (GIS) test.

B-OUTPUT / INPUT (CAT III / 300 V)

The **B** group is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 185). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-55: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name[1]	Editable name of the *CB MC2* module
Phase[1]	Editable phase assignment of the *CB MC2* module
Channel	Channel of the *CB MC2* module
Active	Click a socket symbol to activate or deactivate both channels.[2]
Combine	The **Combine** check box is selected by default and this option cannot be changed by the user. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name[1]	Editable name of the *CB MC2* channel
Charge	Indicates the charge status of the *CB MC2* module.
LED	Click the LED symbol to identify the connected *CB MC2* module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.
2. Only channel 1 is used for the timing measurements. Channel 2 is used for current output.

9. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

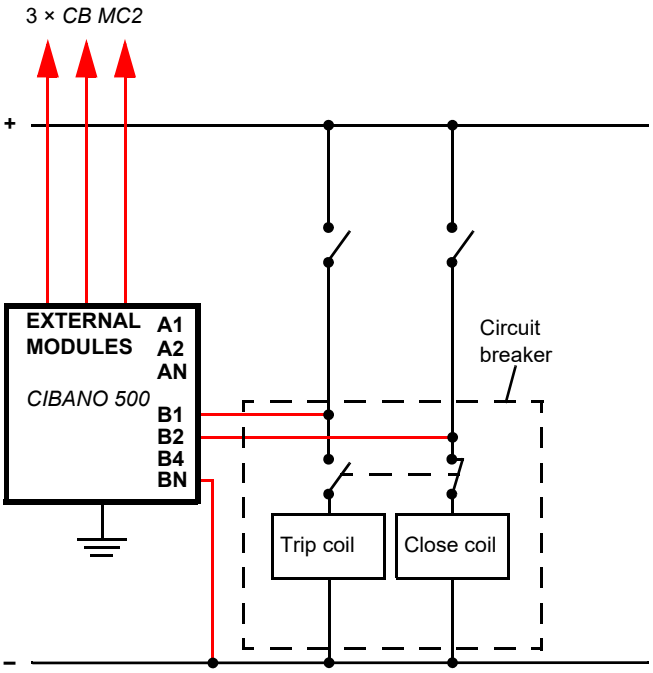


Figure 17-42: Typical measurement setup for the Timing (GIS) test

For the circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**.

WARNING

Death or severe injury caused by high voltage or current possible

- ► If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ► Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing (GIS) test.

Table 17-56: Timing (GIS) test settings

Setting	Description
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils with the source connected to **V IN**.
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,3]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively. **Note:** To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency[3]	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each *CB MC2* current channel[4]
Other	
Close breaker before test[5]	Select the **Close breaker before test** check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate[6]
Contact bounce filter	
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact will be considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** if the motor is supplied from the station supply or battery without any connection to *CIBANO 500* or if the station battery is connected to the **V IN** section and supplied, for example, via the **B4** socket. **Note:** We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Motor supply voltage[3,4]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[3]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

Table 17-56: Timing (GIS) test settings (continued)

Setting	Description
Sequence	
O	Perform an open sequence
C	Perform a close sequence
OC[7]	Perform a reclose sequence
CO[7]	Perform a trip-free sequence
O-CO[7]	Perform an O-CO sequence

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source
4. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
5. The **Close breaker before test** check box is only active if the test sequence begins with the open command.
6. We recommend 40 kHz to get the most accurate test results.
7. See Table 17-57: "Timing (GIS) test sequences" on page 200.

The following table explains the sequences of the Timing (GIS) test.

Table 17-57: Timing (GIS) test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

2. In the **Assessment** area, configure the assessment.
   ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.

4. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

► Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.
   The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-58: Operating times

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation[1]
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation[1]
Closing time	Contact closing time of C, CO and O-CO operation[1]
Closing sync.	Closing synchronization time of C, CO and O-CO operation[1]
Reclosing time	Contact reclosing time of OC operation[1]
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation[1]
Close-open time 1	Contact close-open time of CO and O-CO operation[1]
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation[1]
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-59: Auxiliary contact characteristics[1]

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-60: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 211.

17.3.5 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
   Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

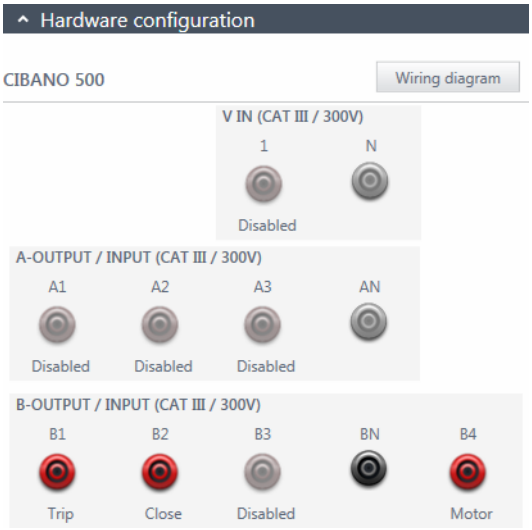


Figure 17-43: Hardware configuration of the Minimum Pickup test

Table 17-61: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)[1]	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled
A3	Motor C or disabled
AN	Common neutral connection for outputs/inputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Common neutral connection for outputs/inputs in group **B**
B4	Motor or disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.

3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-62: Minimum Pickup test settings

Setting	Description
Coil supply	
Supply setting[1]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[2]	Coil supply frequency (AC only)
Supply during coil supply	
Enable	Select the **Enable** check box to supply voltage on the **B3** socket during test execution.[3]
Supply voltage	Voltage supplied on the **B3** socket (same as the coil supply voltage)

Table 17-62: Minimum Pickup test settings (continued)

Setting	Description
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Command impulse duration	Duration of the command pulse of the automated test sequence
Pause between impulses	Time interval between impulses of the automated test sequence
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[2,4]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[2]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.
4. Only available if *CIBANO 500* is selected as source

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.
3. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 12.1 "Test control commands" on page 78) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.
4. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

5. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Measurement Start/Stop** button on the *CIBANO 500* front panel.

   Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

Table 17-63: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

In case of three different trip coils, the trip coils can trip at different voltages. After the last pole has tripped the test will stop and show the worst case result.

Note: If there is an active discordance protection in place you must deactivate it for this test to avoid tripping of the other phases due to the discordance protection instead of the minimum pickup test.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 211.

17.3.6 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, you can configure the test but after pressing the **Start** button *Primary Test Manager* stops running and a missing license message appears. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "–" or neutral contact of the motor.

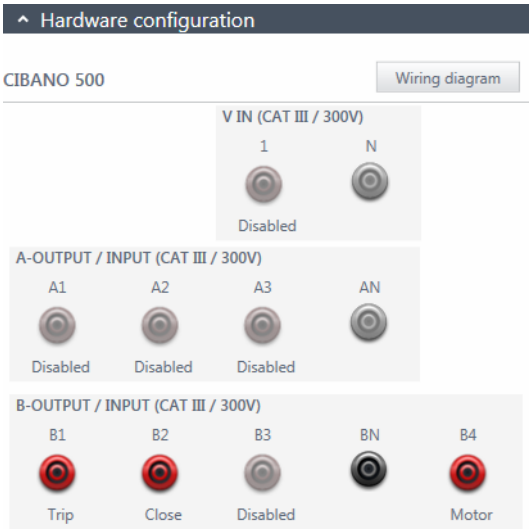


Figure 17-44: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-64: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or disabled
N	Neutral connection of **V IN**
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or disabled
A2	Motor B or disabled
A3	Motor C or disabled
AN	Common neutral connection for outputs/inputs in group **A**
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or disabled
B2	Close or disabled
B3	Supply or disabled
BN	Neutral connection of outputs in group **B**
B4	Motor or disabled

4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect *CIBANO 500* to the motor of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

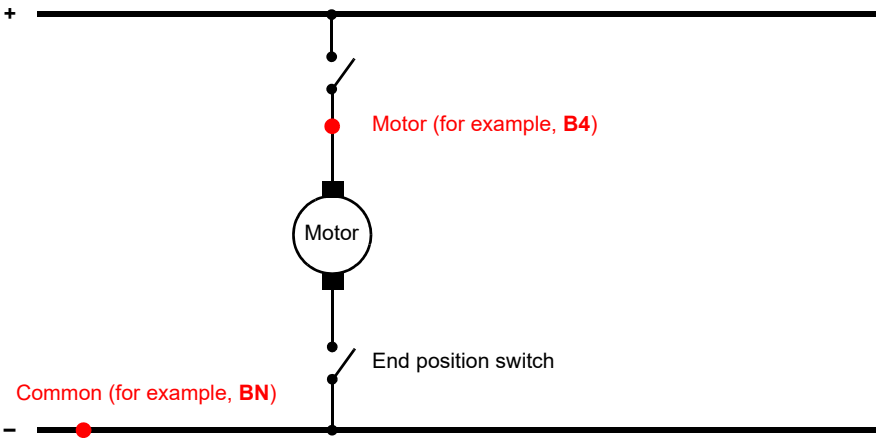


Figure 17-45: Connecting *CIBANO 500* to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-65: Motor Current test settings

Setting	Description
Motor supply	
Supply source	Click **CIBANO 500** to supply the motor with *CIBANO 500*. Click **External source** to supply the motor externally.
Motor supply voltage[1,2]	Voltage of the motor supply Click **AC** or **DC** for AC or DC motor supply voltage respectively.
Test frequency[1]	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Click **CIBANO 500** to supply the coils with *CIBANO 500*. Click **External source** to supply the coils externally.
Supply setting[3]	Select a preconfigured supply setting from the asset data or select **Custom** to enter a custom voltage setting.
Coil supply voltage[2,2]	Rated voltage of the coil supply Click **AC** or **DC** for AC or DC coil supply voltage respectively.
Test frequency[1]	Coil supply frequency (AC only)
Other	
Sample rate	Measurement sample rate

1. Data taken from the nameplate
2. Only available if *CIBANO 500* is selected as source
3. Only available in the guided test workflow

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

   Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.

5. After the charging process has finished, *CIBANO 500* stops the measurement automatically.
   The lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

The following figure shows an example of the Motor Current test graphical results.

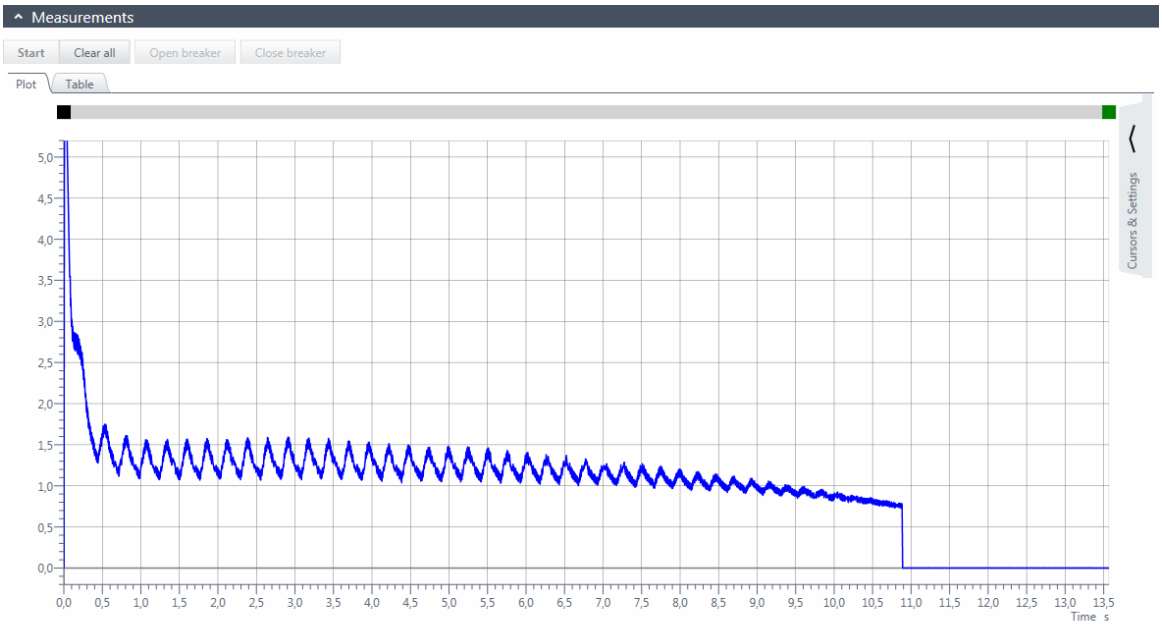


Figure 17-46: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-66: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:

1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green warning light on the *CIBANO 500* front panel is on and the warning symbol on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the safe area.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ► Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not proceed without grounding the test object's terminals.
- ► Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ► Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.4 Demagnetization

On circuit breakers like gas insulated switchgears (GIS), dead tank circuit breakers and hybrid circuit breakers, current transformers are typically integrated in the main contact path. After each performed test on the circuit breaker or due to DC components during a short circuit the current transformers might be magnetized. This magnetism can be caused by DC currents flowing through the primary side of the current transformer. The Demagnetization feature is designed to demagnetize the current transformers from the primary side. Consequently, you do not need to disconnect the current transformers from the secondary side.

The Demagnetization function as featured by *CIBANO 500*, needs to apply at least 30 A through the primary side of the current transformer. If this cannot be assured, use the OMICRON *CTAnalyzer* instead and demagnetize the current transformers from their secondary side.

Note: To check the maximum continuous output current of your *CIBANO 500* test system, contact OMICRON Technical Support (see "Support" on page 277).

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not use external power sources for the circuit breaker's main contacts.
- ► During the test, supply the circuit breaker's main contacts only with *CIBANO 500*.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Demagnetization.

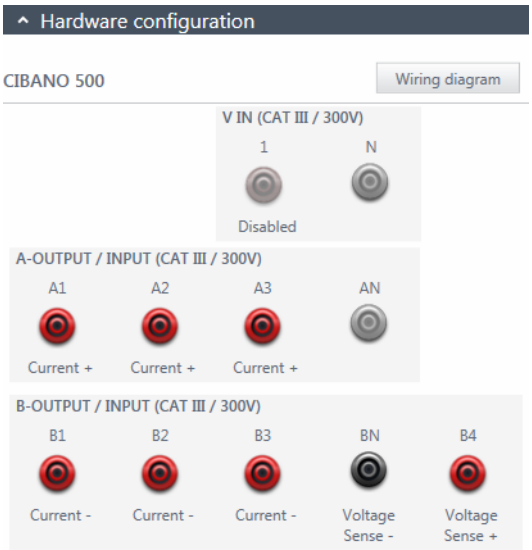


Figure 17-47: Hardware configuration of the Demagnetization

Table 17-67: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Current +
A2	Current +
A3	Current +
AN	Not connected in this test
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Current –
B2	Current –
B3	Current –
BN	Voltage Sense –
B4	Voltage Sense +

2. Make sure that all cable connectors are clean and dry before being tightly connected.

3. Connect *CIBANO 500* to the main contact of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

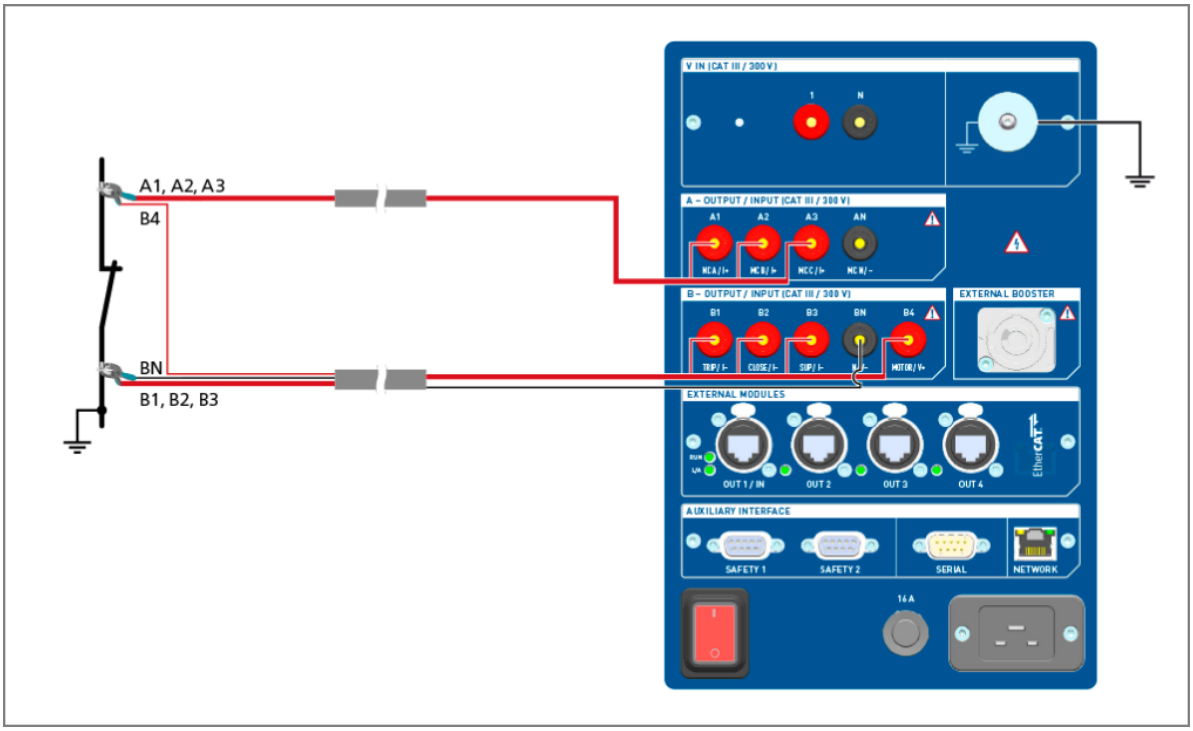


Figure 17-48: Default wiring diagram of the Demagnetization

Tips & Tricks: For easy connection use the delivered multi-core cables and connect the end with the short wires to the *CIBANO 500* sockets according to the short-wire labels. Connect the cable end with the long wires according to the wiring diagram to the corresponding Kelvin clamp. The black **AN** cable is not needed for this test and remains unconnected.

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. We recommend using only the red connectors of the Kelvin clamps (which is the current path) when connecting to the contact fingers of a circuit breaker. Use a separate clamp for the voltage sense cables (**BN** and **B4**) which can be mounted closer to the circuit breaker contact. If the connection is set up properly the resistance decreases when the voltage sense clamps are connected closer to the circuit breaker contact. The polarity of connection does not matter for this test.

Procedure

To demagnetize the circuit breaker's current transformers:

1. In the **Settings and conditions** area, enter the settings of the Demagnetization.

Table 17-68: Demagnetization settings

Setting	Description
CT settings	
Number of CT cores (per phase)	Number of cores of the circuit breaker's current transformers If the number of current transformers cores is not known, select the **Unknown** check box.
Other	
Single side grounded Both side grounded	Select the **Single side grounded** or **Both side grounded** option.

2. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

3. Start the demagnetization by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

4. After the initialization and analysis have finished, press the **Measurement Start/Stop** button again.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.

5. *Primary Test Manager* displays the demagnetization progress.

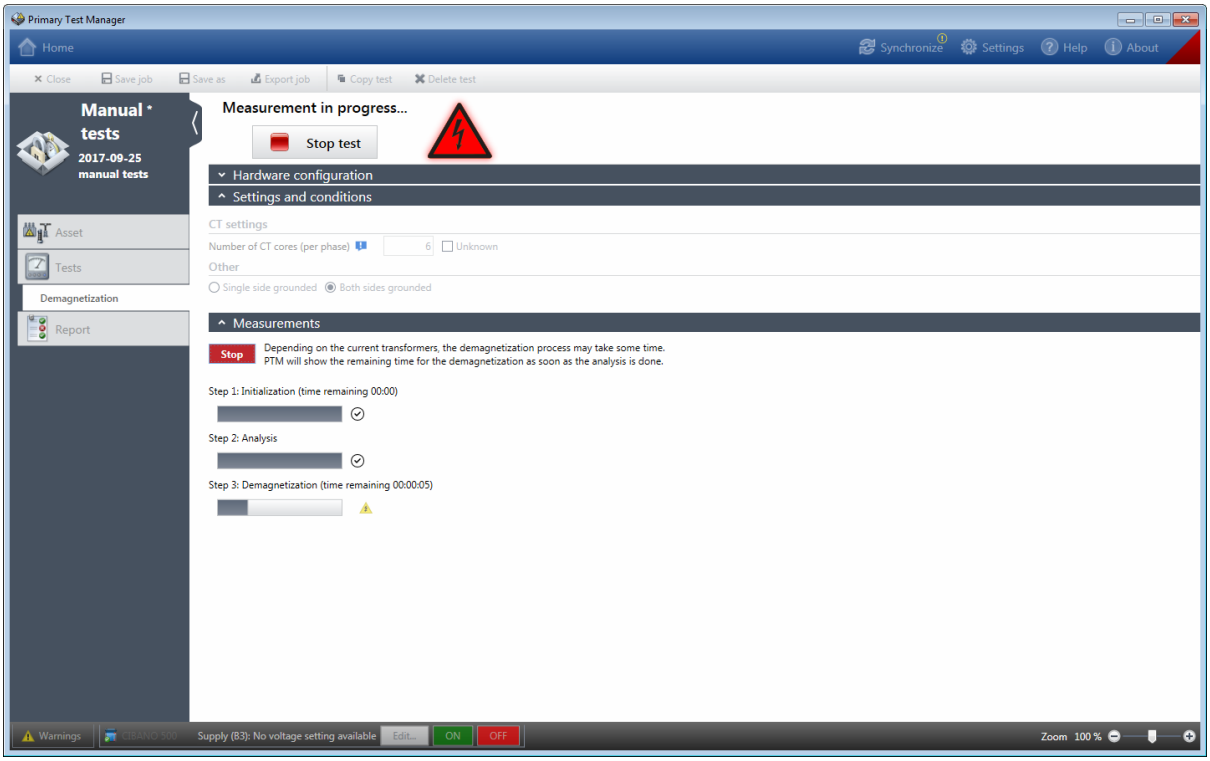


Figure 17-49: Demagnetization progress

6. After the demagnetization has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green warning light is on.

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:

1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green warning light on the *CIBANO 500* front panel is on and the warning symbol on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the safe area.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ► Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not proceed without grounding the test object's terminals.
- ► Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ► Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.5 Testing circuit breakers with *CIBANO 500* and the *CB TN3* modules

Within the scope of the Timing and Dynamic Contact Resistance tests, you can also measure the displacement of the circuit breaker's main contacts during operation by using the *CB TN3* modules. The following procedures apply to *CIBANO 500* with both the EtherCAT® and the Auxiliary module.

17.5.1 Timing test

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB TN3* to *CIBANO 500* with the EtherCAT® cable.
3. Hang up the *CB TN3* close to the circuit breaker's mechanical moving part.
4. Connect the transducer to the *CB TN3* with the delivered cable.
5. Attach the transducer to the circuit breaker. For detailed information, see 18 "Transducers" on page 231.
6. Repeat steps 2 to 5 for all *CB TN3* modules you want to connect.
7. In *Primary Test Manager*, open the Timing test.

8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB TN3* modules.
   The following figure shows the hardware configuration of *CIBANO 500* with the Auxiliary module with one *CB TN3* module connected. For the hardware configuration options of *CIBANO 500*, see Table 17-12: "Hardware configuration options of CIBANO 500" on page 121.

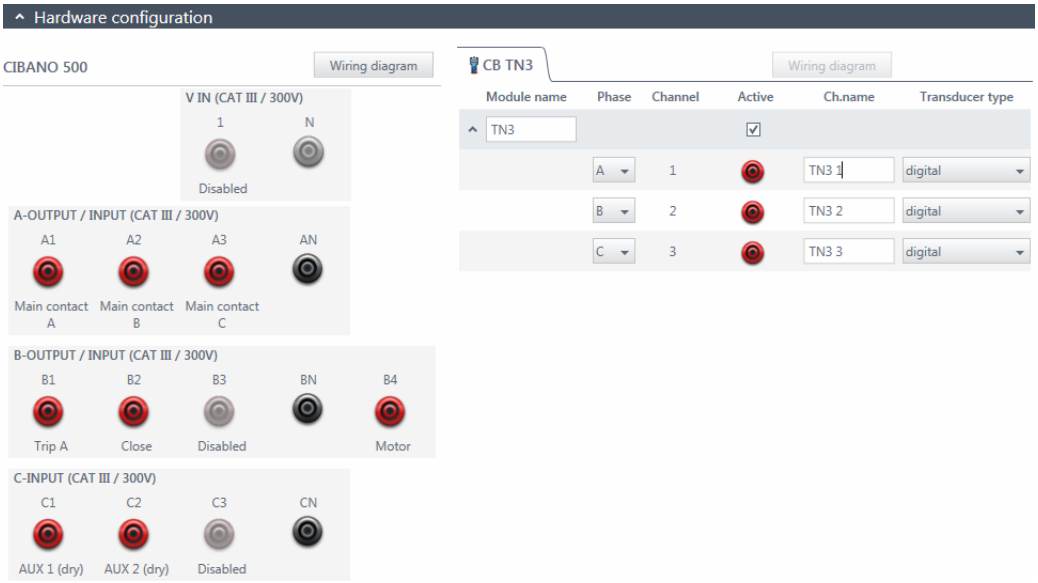


Figure 17-50: Example of the hardware configuration of the Timing test for measuring the main contact travel during operation

Table 17-69: Hardware configuration options of the *CB TN3* module

CB TN3	Option
Module name[1]	Editable name of the *CB TN3* module
Phase	Phase to which the *CB TN3* module is connected
Channel[1]	Editable name of the *CB TN3* channel. Click the socket symbol to activate or deactivate the channel depending on the connections made.
Active	Click the socket symbol to activate or deactivate the channel.
Ch.name[1]	Editable name of the *CB TN3* channel
Transducer type	Type of the connected transducer: digital or analog

1. Permanently stored in the *CB TN3* memory. You can, for example, rename the *CB TN3* modules depending on the connection point.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the transducer settings. For the *CIBANO 500* settings, see Table 17-13: "Timing test settings" on page 123.

Table 17-70: Transducer settings[1]

Setting	Description
Digital transducer settings	
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel name set in the *CB TN3* hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per one pulse
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 87).[2,3]
Analog transducer settings	
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel name set in the *CB TN3* hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per 1 V
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 87).[2,3]
Calibrate	Click **Calibrate** to calculate the transducer resolution (see "Calibration" later in this section).

1. Only available if the *CB TN3* module is connected
2. The selected conversion table remains associated with the test even after it has been deleted from the asset.
3. When performing a manual test, you can load a conversion table by clicking the **Browse** button **…** in the Conversion data column.

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.
5. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

When testing with the *CB TN3* modules, *Primary Test Manager* calculates and displays also the velocity of the contact travel. You can set the display options for the velocity data on the **Settings** tab in the Cursors & settings workspace.

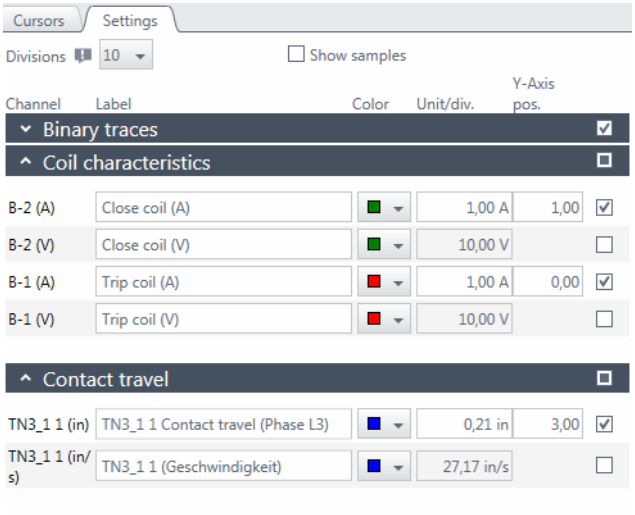


Figure 17-51: Setting the velocity display options

To view the numeric measurement data, click the **Table** tab. For the operating times, auxiliary contact characteristics and coil characteristics, see Table 17-36: "Operating times" on page 162, Table 17-37: "Auxiliary contact characteristics" on page 162 and Table 17-39: "Coil characteristics" on page 163.

The following figure explains the contact travel characteristics defined in Table 17-71: "Contact travel characteristics" later in this section.

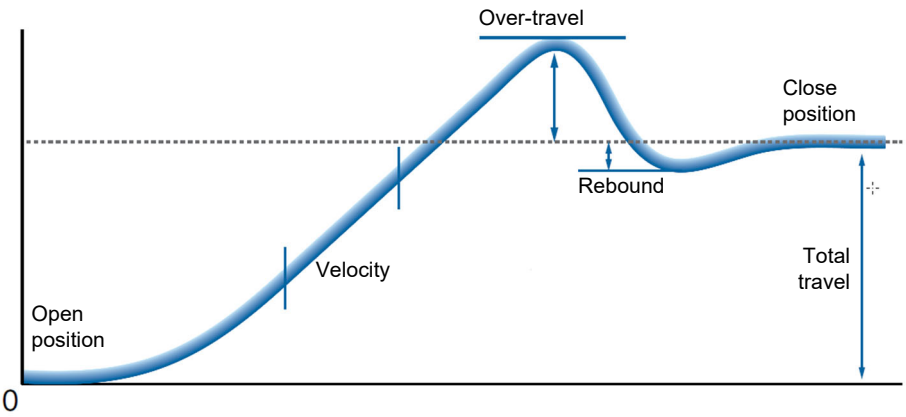


Figure 17-52: Contact travel characteristics

Table 17-71: Contact travel characteristics[1]

Data	Description
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel of the *CB TN3* module
Total travel	Total distance traveled by the contact during operation (excluding possible over-travel). The row labeled with the *CB TN3* channel displays the maximum of all measurement results for this channel.
Over-travel	Contact travel distance between the maximum contact travel and the final contact resting position
Rebound	Contact travel distance between the minimum contact travel after returning from an over-travel and the final contact resting position
Assessment	Measurement assessment
Velocity zone definition	Time period within which the contact travel velocity is evaluated (see 15.4 "Velocity zones" on page 97)
v meas	Measured velocity of the contact travel within the velocity zone
Information	Information about the measurement
Assessment	Measurement assessment

1. Only available for O and C sequences

Table 17-72: Main contact characteristics[1]

Data	Description
Main contact	Main contact this measurement row refers to
Travel data	*CB TN3* channel this measurement row refers to
Contact wipe	Distance the contact travels between the first contact touch and the contact steady state
Bounce time[2]	Duration of the main contact bounce
Bounce count[2]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences
2. Not available if the **Measure PIR** check box is selected

Calibration

With *Primary Test Manager*, you can calibrate analog transducers when using them. To calibrate an analog transducer:

1. In the **Hardware configuration** area, select the analog transducer type.
2. In the **Settings and conditions** area, click **Calibrate**.
3. In the **Transducer Calibration** dialog box, enter the maximum stroke of the transducer, and then click **Start**.
4. Press the **Measurement Start/Stop** button on the *CIBANO 500* front panel.
5. During the calibration time (10 seconds), move the transducer manually from the minimum to maximum position.
6. After the calibration process has finished, the calculated transducer resolution appears in the **Settings and conditions** area.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 229.

17.5.2 Dynamic Contact Resistance test

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ► Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ► Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB TN3* to *CIBANO 500* with the EtherCAT® cable.
3. If the *CB TN3* modules are not connected from the last test, hang up the *CB TN3* close to the circuit breaker's mechanical moving part.
4. Connect the transducer to the *CB TN3* with the delivered cable.
5. Attach the transducer to the circuit breaker. For detailed information, see 18 "Transducers" on page 231.
6. Repeat steps 2 to 5 for all *CB TN3* modules you want to connect.
7. In *Primary Test Manager*, open the Dynamic Contact Resistance test.

8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB TN3* modules.
   The following figure shows the hardware configuration of *CIBANO 500* with the EtherCAT® module with one *CB MC2* and one *CB TN3* module connected. For the hardware configuration options of *CIBANO 500* and the *CB MC2* module, see Table 17-40: "Hardware configuration options of CIBANO 500" on page 165 and Table 17-41: "Hardware configuration options of the CB MC2 module" on page 166.

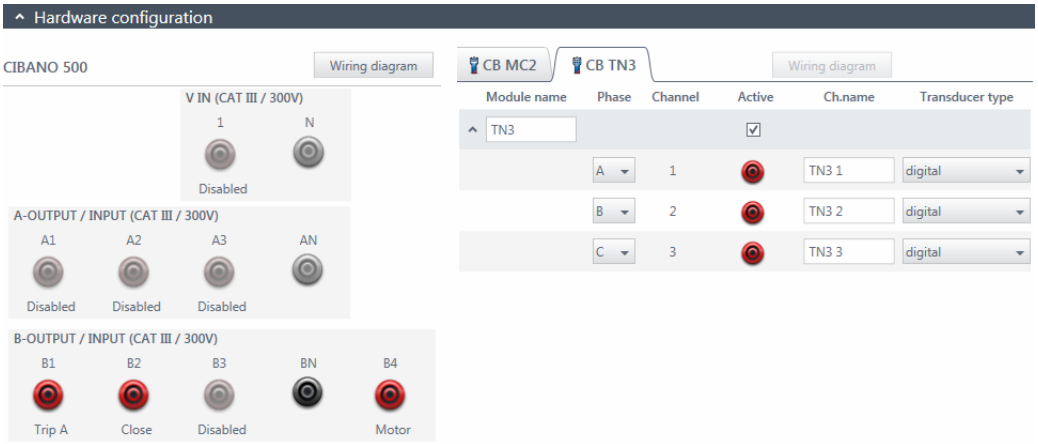


Figure 17-53: Example of the hardware configuration of the Dynamic Contact Resistance test for measuring the main contact travel during operation

Table 17-73: Hardware configuration options of the *CB TN3* module

CB TN3	Option
Module name[1]	Editable name of the *CB TN3* module
Phase	Phase to which the *CB TN3* module is connected
Channel[1]	Editable name of the *CB TN3* channel. Click the socket symbol to activate or deactivate the channel depending on the connections made.
Active	Click the socket symbol to activate or deactivate the channel.
Ch.name[1]	Editable name of the *CB TN3* channel
Transducer type	Type of the connected transducer: digital or analog

1. Permanently stored in the *CB TN3* memory. You can, for example, mark your *CB TN3* modules with the colored stickers and name them according to the colors. You can also rename the *CB TN3* modules depending on the connection point.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the transducer settings. For the *CIBANO 500* and the *CB MC2* settings, see Table 17-42: "Dynamic Contact Resistance test settings" on page 169.

Table 17-74: Transducer settings[1]

Setting	Description
Digital transducer settings	
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel name set in the *CB TN3* hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per one pulse
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 87).[2,3]
Analog transducer settings	
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel name set in the *CB TN3* hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per 1 V
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 87).[2,3]
Calibrate	Click **Calibrate** to calculate the transducer resolution (see "Calibration" later in this section).

1. Only available if the *CB TN3* module is connected
2. The selected conversion table remains associated with the test even after it has been deleted from the asset.
3. When performing a manual test, you can load a conversion table by clicking the **Browse** button **…** in the Conversion data column.

2. In the **Assessment** area, configure the assessment.
   - ► Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
   - ► Select the **Automatic assessment** check box to enable the automatic assessment.

   Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 91.

3. In the **Measurements** area, click **Start**.
   The blue ring on the **Measurement Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ► Stay in the safe area during the test.

4. Start the measurement by pressing the **Measurement Start/Stop** button.
   The blue ring on the **Measurement Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red warning light on the front panel are flashing.
5. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green warning light is on, and *Primary Test Manager* displays the measurement results.

When testing with the *CB TN3* modules, *Primary Test Manager* calculates and displays also the velocity of the contact travel. You can set the display options for the velocity data on the **Settings** tab in the Cursors & settings workspace.

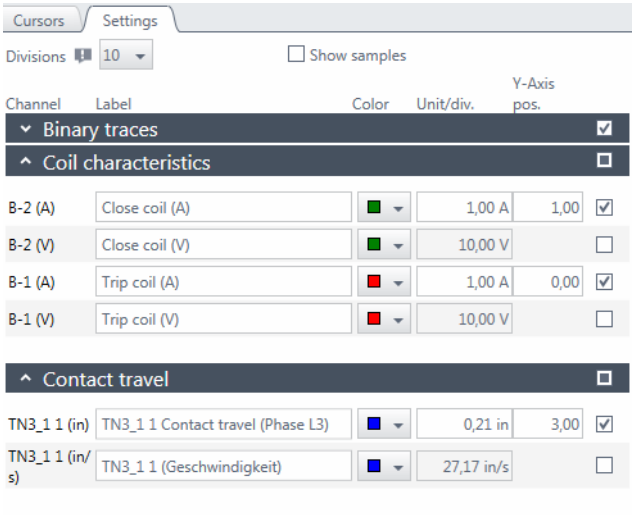


Figure 17-54: Setting the velocity display options

To view the numeric measurement data, click the **Table** tab. For the operating times, auxiliary contact characteristics and coil characteristics, see Table 17-44: "Operating times" on page 173, Table 17-45: "Auxiliary contact characteristics" on page 173 and Table 17-47: "Coil characteristics" on page 174.

For explanation of the contact travel characteristics, see Figure 17-52: "Contact travel characteristics" on page 222.

Table 17-75: Contact travel characteristics[1]

Data	Description
Module	Name of the *CB TN3* module set in the hardware configuration
Channel	Channel of the *CB TN3* module
Total travel	Total distance traveled by the contact during operation (excluding possible over-travel). The row labeled with the *CB TN3* channel displays the maximum of all measurement results for this channel.
Over-travel	Contact travel distance between the maximum contact travel and the final contact resting position
Rebound	Contact travel distance between the minimum contact travel after returning from an over-travel and the final contact resting position
Assessment	Measurement assessment
Velocity zone definition	Time period within which the contact travel velocity is evaluated (see 15.4 "Velocity zones" on page 97)
v meas	Measured velocity of the contact travel within the velocity zone
Information	Information about the measurement
Assessment	Measurement assessment

1. Only calculated for O and C sequences

Table 17-76: Main contact characteristics[1]

Data	Description
Main contact	Main contact this measurement row refers to
Travel data	*CB TN3* channel this measurement row refers to
Contact wipe	Distance the contact travels between the first contact touch and the contact steady state
Bounce time[2]	Duration of the main contact bounce
Bounce count[2]	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences
2. Not available if the **Measure PIR** check box is selected

Calibration

With *Primary Test Manager*, you can calibrate analog transducers when using them. To calibrate an analog transducer:

1. In the **Hardware configuration** area, select the analog transducer type.
2. In the **Settings and conditions** area, click **Calibrate**.
3. In the **Transducer Calibration** dialog box, enter the maximum stroke of the transducer, and then click **Start**.
4. Press the **Measurement Start/Stop** button on the *CIBANO 500* front panel.
5. During the calibration time (10 seconds), move the transducer manually from the minimum to maximum position.
6. After the calibration process has finished, the calculated transducer resolution appears in the **Settings and conditions** area.

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:

1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green warning light on the *CIBANO 500* front panel is on and the warning symbol on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the safe area.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ► Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect all *CB TN3* modules first from *CIBANO 500* and then from the transducers, if connected.
8. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not proceed without grounding the test object's terminals.
- ► Ground the test object's terminals by using a grounding set.

9. Disconnect the *CB MC2* from the main contact of the circuit breaker.
10. Unhook the *CB MC2* from one phase of the circuit breaker.
11. Repeat steps 7 to 9 for all phases tested.

12. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ► Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

18 Transducers

This section describes how to use the transducers for measuring the circuit breaker's contact travel with *CIBANO 500* and the related issues. The emphasis is on the attachment of the transducers to the circuit breaker.

Motion measurements are a well proven and widely used method to assess the mechanical linkage of a circuit breaker. To benefit from this method, you have to connect a travel sensor.

There are following options, priority-wise ordered:

1. Use the same connection point as used by the manufacturer during factory routine tests.
2. Use the same connection point as during the commissioning of the circuit breaker on site.
3. Connect the travel sensor as close to the main contacts as possible. However, do not touch the integrity of the circuit breaker.
4. On a ganged operated circuit breaker – Pick the pole which is closest to the spring operating mechanism.

18.1 Angular transducers

The angular transducers are used to derive motion curves from a rotating part of the circuit breaker. There is a mechanical coupling between the transducer and the circuit breaker.

18.1.1 Components

The following components are typically required to perform measurements by using the angular transducer.

Transducer and adapter

The angular transducer comes with an adapter which facilitates attaching the transducer to the articulating arm described later in this section. The adapter has five threaded holes (M8) for mounting flexibility. To enhance the number of options for fixing the transducer, three additional holes with a diameter of 8.2 mm are available.

Figure 18-1: Angular transducer

Articulating arm and screw clamp

The articulating arm consists of two levers coupled by a ball joint. On the ends of the levers, the ball joints hold a threaded stub for interfacing with other mechanical components. All three joints can be fixed with a single set screw. The articulating arm is connected on one side to the screw clamp and on the other side, it holds the transducer.

Figure 18-2: Articulating arm

The screw clamp is attached directly to the circuit breaker. It has a ball joint for connecting the articulating arm or the mechanical extensions described later in this section. The ball joint can be fixed by bringing the lever in the corresponding position.

Figure 18-3: Screw clamp

Extensions

Two types of extensions of length 100 mm and 50 mm are available to increase the range of the articulating arm. The extensions can be inserted at either end of the articulating arm.

Figure 18-4: Articulating arm extensions

Couplings

Two types of couplings are available for the angular transducers: a flexible coupling and a coupling using a drill chuck. The couplings are used to connect the shaft of the angular transducer to a rotating part of the circuit breaker. The diameter of the hole of the flexible coupling is 10 mm, the drill chuck accepts shafts with diameters between 0.8 mm and 10 mm.

Figure 18-5: Flexible coupling

Figure 18-6: Coupling with a drill chuck

Mounting kit

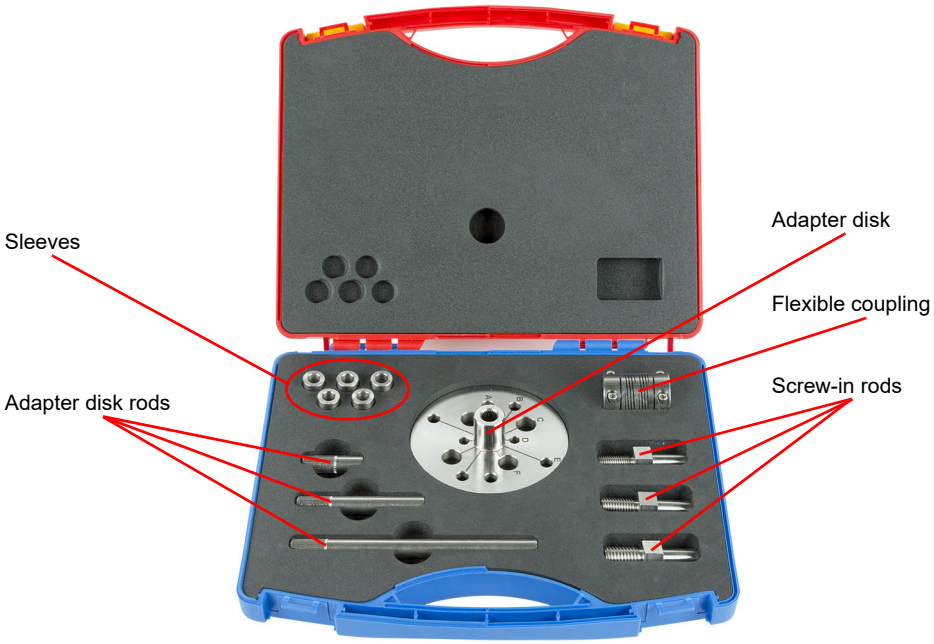


Figure 18-7: Mounting kit

The following table shows examples of circuit breakers fitting the drill holes in the adapter disk. You can use the mounting kit for any other circuit breakers which fit the drill holes.

Table 18-1: Examples of circuit breakers fitting the adapter disk

Character on the disk	Circuit breaker
A	Siemens SPS/3AP <72.5 kV
B	Siemens SPS/3AP 72.5 kV – 145 kV
C	ABB HPL/LTB >145 kV
D	Alstom GL >72.5 kV
E	Siemens 3AP >145 kV
F	ABB HPL/LTB >145 kV

18.1.2 Installation and measurement setup

The angular transducer has to be installed directly in front of the rotating shaft (axial alignment) of the circuit breaker. Before installing the transducer, check that there is enough space for mounting the screw clamp and the articulating arm.

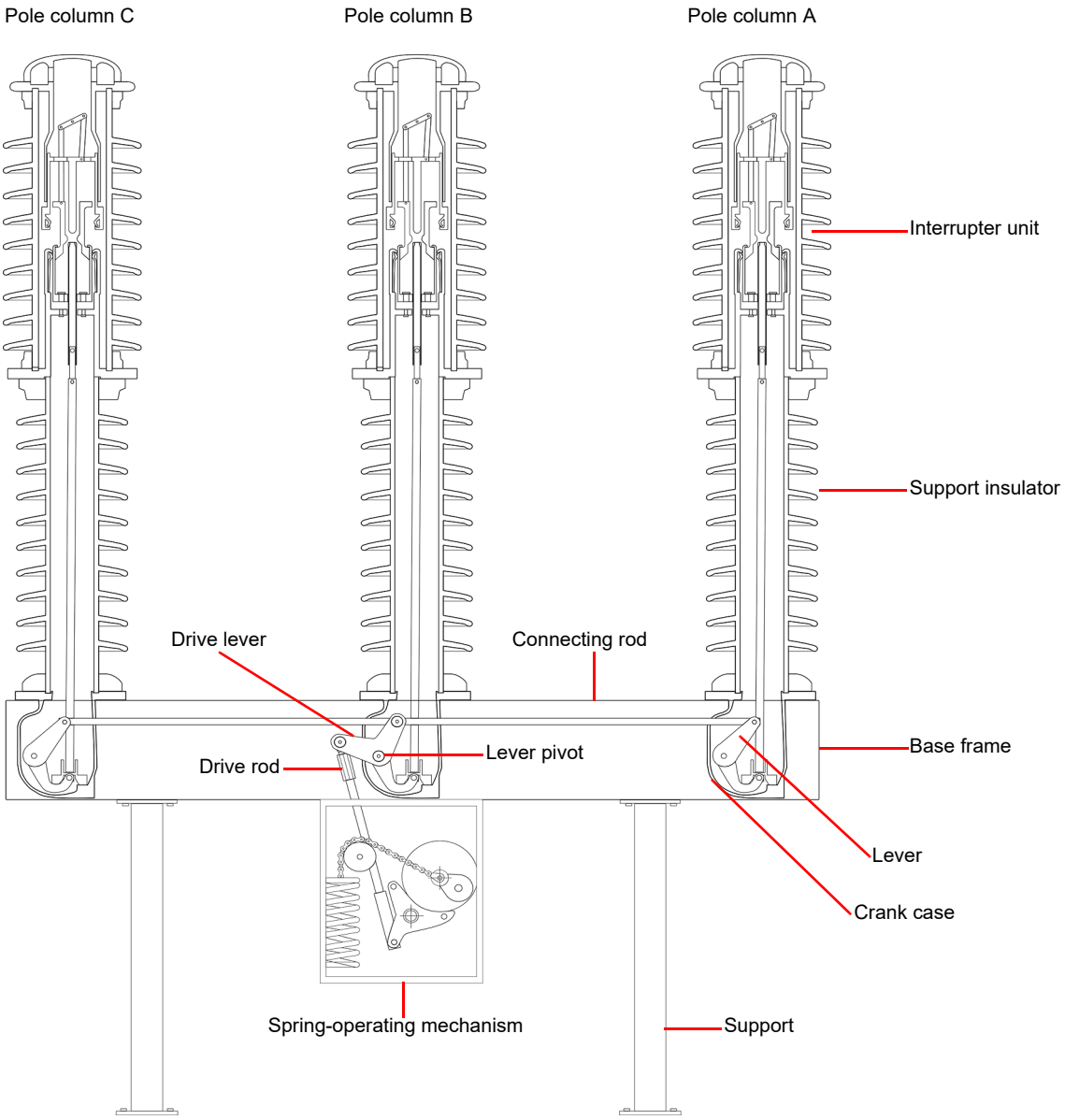


Figure 18-8: Spring-operated live-tank high-voltage circuit breaker

To install an angular transducer:

1. Attach the flexible coupling and the drill chuck, if necessary, to the rotating shaft of the circuit breaker.
2. Mount the screw clamp and the articulating arm holding the transducer in the optimal position in front of the rotating shaft on the circuit breaker.

3. Fit the shaft of the transducer into the hole of the flexible coupling and tighten the screws.
4. Fix the articulating arm by using the set screw and the joint of the screw clamp by switching the lever to the corresponding position.
5. Connect the cable of the transducer to one digital interface of the *CB TN3* module.
6. Configure the *CB TN3* digital interface in *Primary Test Manager*.

If it is possible to exchange the screw on the lever pivot, mount the travel sensor as described in Figure 18-9 and Figure 18-10.

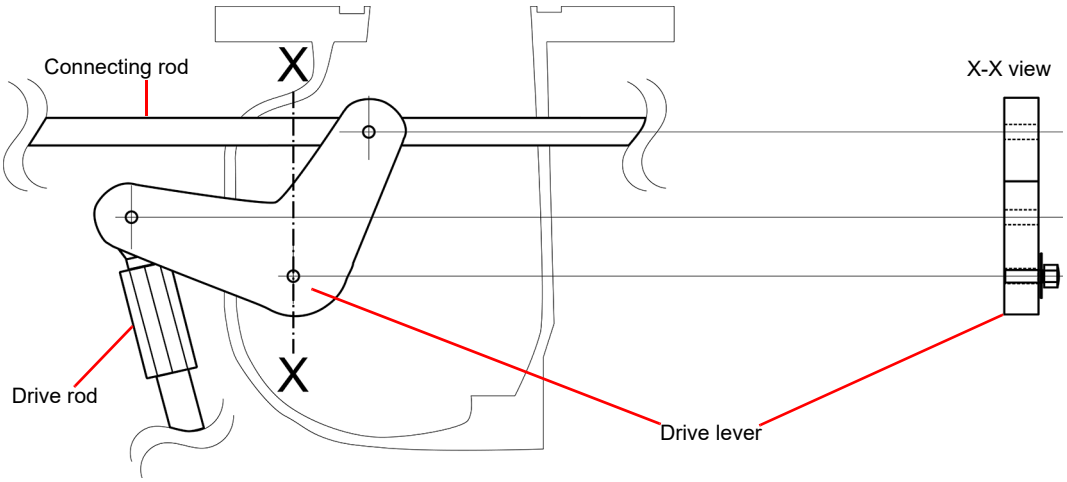


Figure 18-9: Lever (X-X view) where the screw at the pivot point of the lever can be exchanged

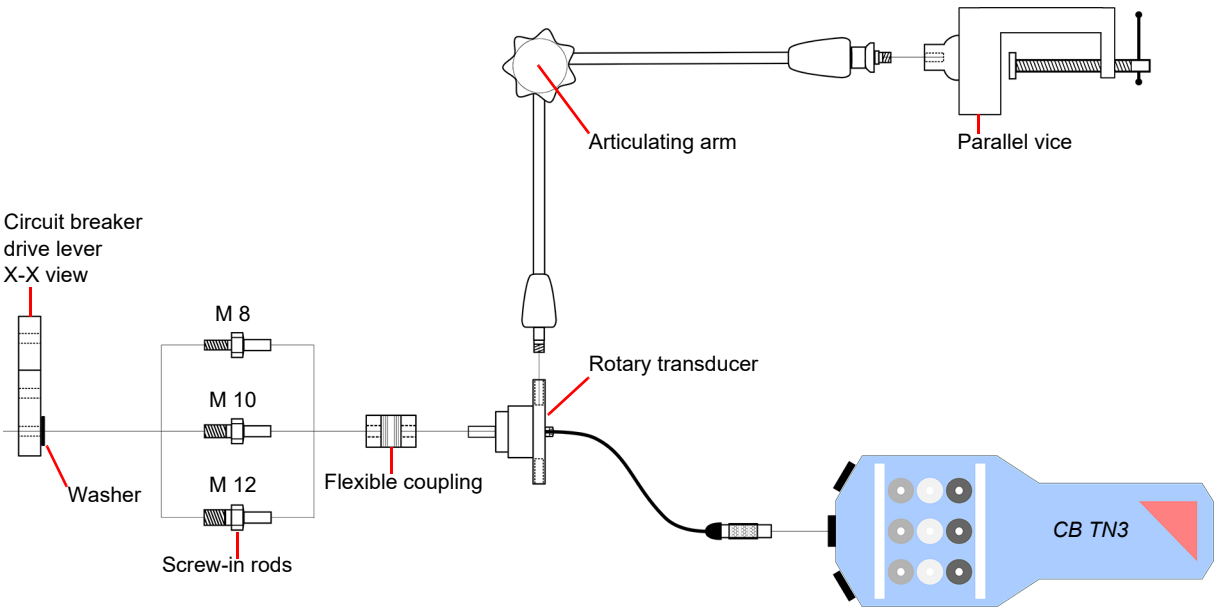


Figure 18-10: Use screw-in rods to apply OMICRON motion transducer to the drive lever of the circuit breaker

If it is not possible to exchange the screw on the lever pivot, mount the travel sensor as described in Figure 18-11 and Figure 18-12.

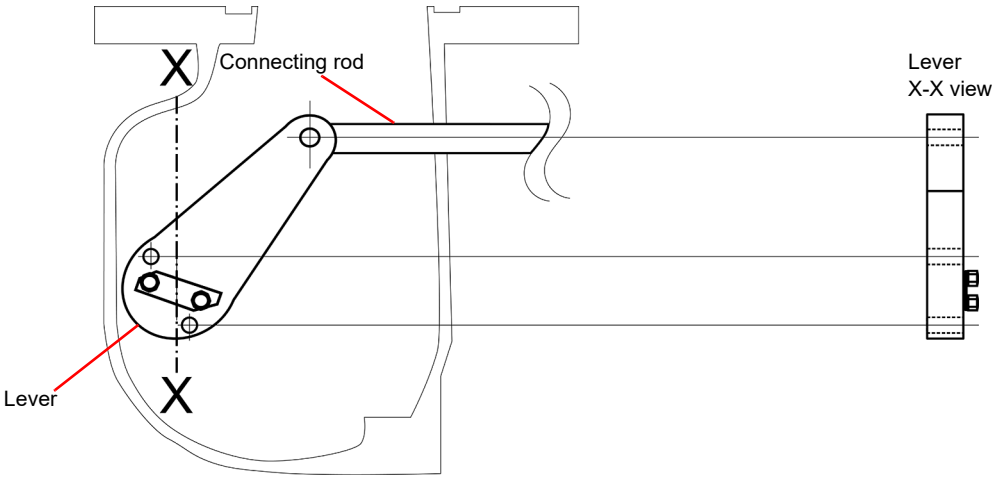


Figure 18-11: Lever (X-X view) where the screw at the pivot point of the lever cannot be exchanged

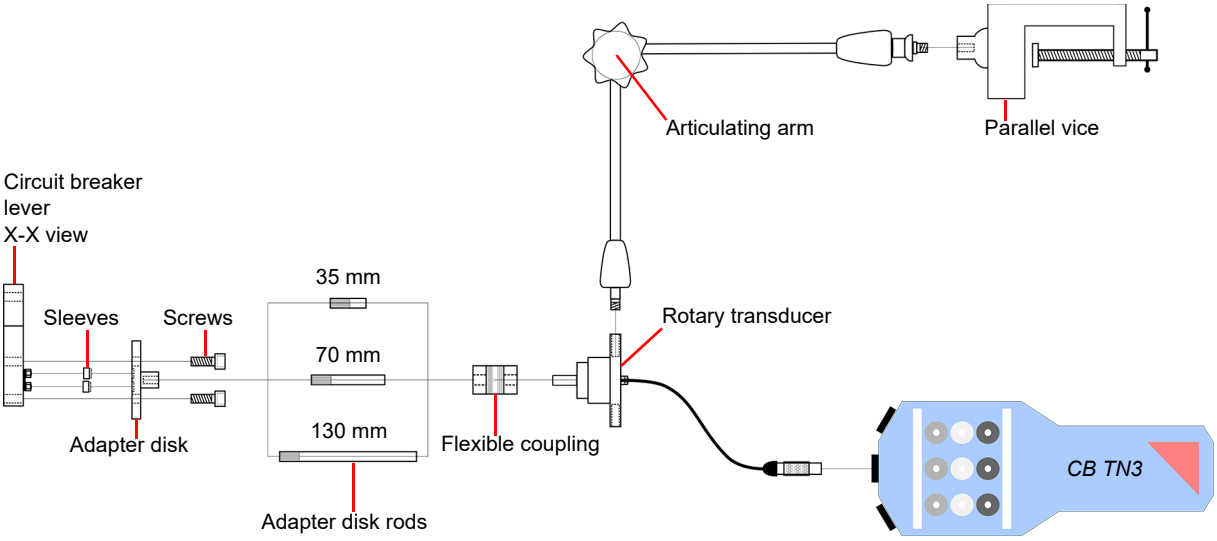


Figure 18-12: Use the adapter disk to apply OMICRON motion transducer to the drive lever of the circuit breaker

18.1.3 Technical data

The following specifications apply to angular transducers supplied by OMICRON.

Table 18-2: Angular transducer specifications

Characteristic	Rating
Resolution	0.025º
Maximum velocity	5000 rpm
Supply voltage	5 V DC

18.2 Linear transducers

The linear transducers are used to derive motion curves from a linearly moving part of the circuit breaker. Alternatively, the linear transducers can translate the rotation of a shaft into a motion curve if the diameter of the shaft is large enough. There is no mechanical connection between the circuit breaker and the transducer.

18.2.1 Components

The following components are typically required to perform measurements by using the linear transducer.

Transducer and adapter

The linear transducer comes with an adapter which facilitates the transducer to the articulating arm described earlier in this chapter.

Figure 18-13: Linear transducer

Magnetic tape

The magnetic tape is the “scale” for the linear transducer. It is either fixed onto the flat surface of a moving part of the circuit breaker or wrapped around a rotating shaft. Usually, a double-sided adhesive tape is used for the mechanical bond between the tape and the circuit breaker.

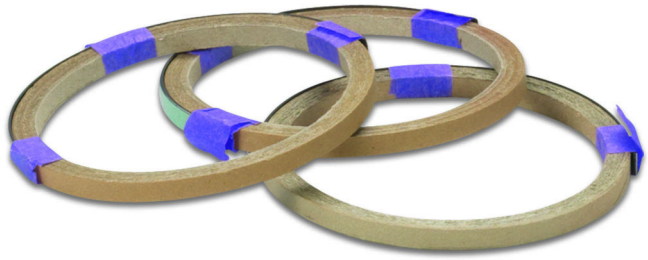


Figure 18-14: Magnetic tapes

Adhesive tapes

Adhesive tapes are used to fix the magnetic tapes to the circuit breaker. The double-sided adhesive tape can be used for flat mounting surfaces. Both double-sided and standard adhesive tapes support mounting of the magnetic tape on the perimeter of a shaft (“wrapping the magnetic tape around a shaft”).

Figure 18-15: Double-sided adhesive tape

Articulating arm and screw clamp

For information about the articulating arm and the screw clamp, see "Articulating arm and screw clamp" on page 232.

Extensions

For information about the extensions, see "Extensions" on page 233.

18.2.2 Installation and measurement setup

Before installing the linear transducer, evaluate the options of attaching the magnetic tape on a part of the circuit breaker that undergoes a linear or a nearly linear motion during switching operation. Alternatively, evaluate the options of attaching the magnetic tape to a rotating shaft of the circuit breaker. The minimum diameter of the shaft is 20 mm. Below this diameter the accuracy specifications are no longer guaranteed.

To install a linear transducer:

1. Place the transducer such that the gap between the magnetic tape and the read head is between 0.1 mm and 3 mm. Evaluate the options of connecting the screw clamp in conjunction with the articulating arm such that the transducer can be held in the desired position.
2. Mount the screw clamp and the articulating arm holding the transducer in the optimal position.
3. Fix the articulating arm by using the set screw and the joint of the screw clamp by switching the lever to the corresponding position.
4. Connect the cable of the transducer to one digital interface of the *CB TN3* module.
5. Configure the *CB TN3* digital interface in *Primary Test Manager*.

18.2.3 Technical data

The following specifications apply to linear transducers supplied by OMICRON.

Table 18-3: Linear transducer specifications

Characteristic	Rating
Resolution	10 µm
Maximum velocity	25 m/s
Supply voltage	5 V DC

18.3 Transducer for the ABB HMB driving mechanism

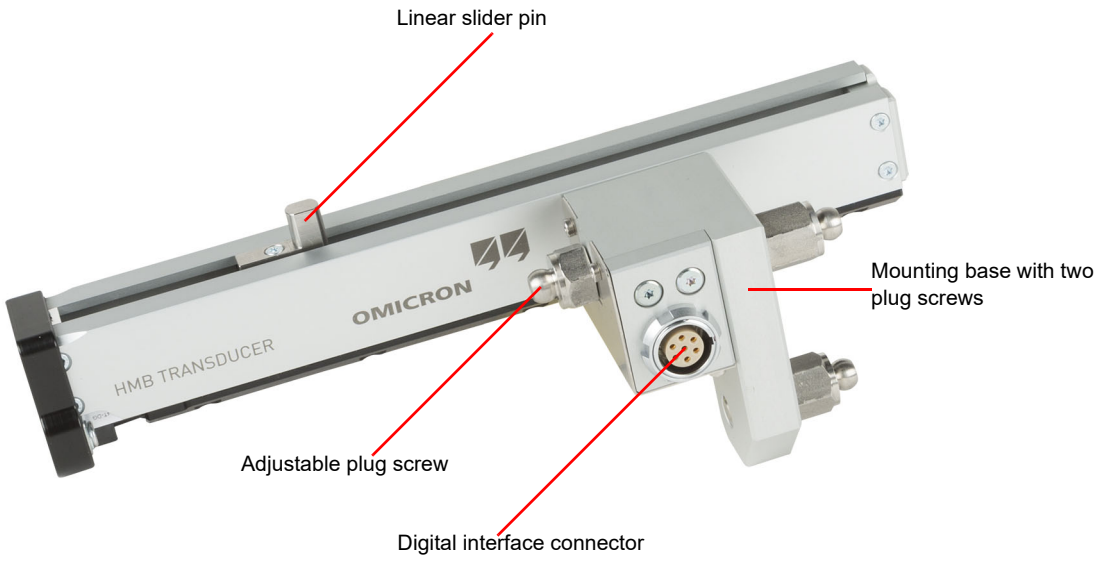


Figure 18-16: Transducer for the ABB HMB circuit breaker driving mechanism

18.3.1 Installation and measurement setup

► Before starting to mount or to link a digital linear transducer, bring the circuit breaker into the open position, discharge the disc spring column completely and de-energize the pump module which primes the disc spring.

To mount the digital linear transducer:

1. Protect the circuit breaker drive rod with a clean cloth.
2. Screw in the adjustable plug screw completely.
3. In the driving mechanism, locate the hole where the linear slider pin should be placed.
4. Insert and guide the transducer above the drive rod carefully and gently.
5. Insert the linear slider pin into the hole of the driving mechanism's moving plate.
6. Insert the two plug screws of the mounting base into the head of the respective Allen screws of the circuit breaker.
7. Unscrew the adjustable plug screw, place its cap head into the upper Allen screw head, and then tighten it gently with an open-ended spanner.
8. Plug the cable into the digital interface connector.
9. Remove the cloth from the circuit breaker's rod.

18.3.2 Technical data

The following specifications apply to transducers made for the ABB HMB driving mechanism supplied by OMICRON.

Table 18-4: Specifications of the transducers for the ABB HMB driving mechanism

Characteristic	Rating
Resolution	9.7609 µm
Supply voltage	5 V DC

19 Troubleshooting

19.1 Connecting to *CIBANO 500*

If you encounter any problems when connecting to *CIBANO 500* we recommend turning off any wireless adapter and VPN software on your computer.

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as follows:

1. Click the **Start OMICRON Device Browser** button .
2. In the **OMICRON Device Browser** window, look for the device you want to connect to and read its IP address.
3. In the home view, click **More** beneath the **Connect** button, and then click **Add device manually**.

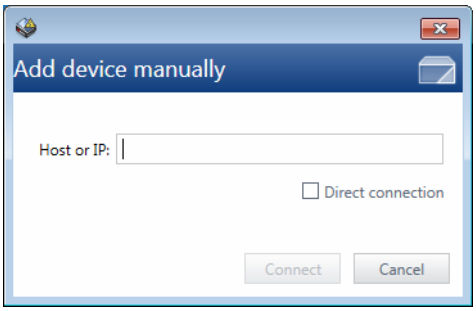


Figure 19-1: **Add device manually** dialog box

4. In the **Add device manually** dialog box, type the IP address of the device you want to connect to.
5. Click **Connect**.

If you assigned a static IP address to the device, you can try to connect as follows:

1. In the **Add device manually** dialog box, select the **Direct connection** check box.
2. In the **Host or IP** box, type cb://*a.b.c.d*, where *a.b.c.d* is the static IP address of the device.

19.2 Firewall configuration

A correct firewall configuration is essential to successfully establish a communication between *CIBANO 500* and your computer.

Note: Any change to the firewall settings mentioned in this section requires administrator rights on your computer.

19.2.1 Windows firewall

The configuration of the Windows firewall is carried out automatically during the installation of *Primary Test Manager*. However, in certain cases this may have no immediate effect.

► To prevent the Windows firewall from blocking communication, (temporarily) disable it via the Windows Control panel.

If you are now able to successfully establish communication, the Windows firewall was the reason for the blocked communication between your test set and your computer.

► Reconfigure the Windows firewall in order to enable a permanent use of the test set without having to disable the Windows firewall.
For more information, see19.2.3 "Manual firewall configuration" later in this section.

19.2.2 Third-party firewall

► If you are using a firewall other than the Windows firewall, temporarily disable it to see if this firewall may be the cause for the blocked communication.

For more information on configuring a third-party firewall to allow a permanent communication between *CIBANO 500* and your computer, see 19.2.3 "Manual firewall configuration" later in this section.

Note: Numerous computer security programs or anti-virus packages also contain an integrated firewall function. Double-check and, if applicable, remove all such programs that may be installed on your computer.

19.2.3 Manual firewall configuration

If you would like to manually configure your firewall settings, the following ports/services have to be open in order to get a functional communication.

Table 19-1: Inbound rules

Program/service name	Rule name	Protocol type	Local port	Remote port	Local IP	Remote IP
OMFind.exe[1]	OMICRON OMFind 4987 (UDP-In)	UDP	4987	Any	Any	Any
	OMICRON OMFind 4988 (UDP-In)	UDP	4988	Any	234.5.6.7	Any
	OMICRON OMFind 4987 (UDP-In)	UDP	4987	Any	Any	Any
	OMICRON OMFind 4988 (UPD-In)	UDP	4988	Any	234.5.6.7	Any

1. Default installation path:
   64-bit: C:\Program Files (x86)\Common Files\OMICRON
   32-bit: C:\Program Files\Common Files\OMICRON

Table 19-2: Outbound rules

Program/service name	Rule name	Protocol type	Local port	Remote port	Local IP	Remote IP
Any	OMICRON CIBANO (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
	OMICRON OMFind (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
	OMICRON Primary Test Manager (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
ODBFileMonitor.exe[1]	OMICRON Device Browser File Monitor FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	OMICRON Device Browser File Monitor FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
OMFind.exe[1]	OMICRON OMFind 4988 (UDP-Out)	UDP	Any	4988	Any	234.5.6.7
PTM.exe[2]	OMICRON CIBANO 6643 (TCP-Out)	TCP	Any	6643	Any	Any

1. Default installation path:
   64-bit: C:\Program Files (x86)\Common Files\OMICRON
   32-bit: C:\Program Files\Common Files\OMICRON
2. Default installation path: C:\Program Files\OMICRON\PTM

19.3 *CIBANO 500* does not start

If the mains voltage exceeds the maximum rated level (see Table 20-17: "Power supply specifications" on page 253), an overvoltage protection will disconnect *CIBANO 500* from mains. In this case, the red lamp on the power switch is on and both warning lights on the *CIBANO 500* front panel are off.

First, switch *CIBANO 500* off and wait at least five minutes before powering *CIBANO 500* up again. If *CIBANO 500* still has not started, check the mains voltage and ensure that it does not exceed the maximum permitted rating.

19.4 Hardware self-test

Before performing the first test after *CIBANO 500* has been powered on, a hardware self-test runs for approximately 6 seconds. The self-test checks functionality of the *CIBANO 500* hardware components such as relays, IGBT and amplifiers. If the self-test passed, no action is required. If the self-test failed, *Primary Test Manager* displays detailed information and instructions.

Note: During the self-test, the **Emergency Stop** button must be released.

19.5 Changing the hardware configuration

When you open a prepared test or you connect a test set while having a previously prepared test open, *Primary Test Manager* automatically checks the hardware configuration of your test setup. The following dialog box informs you about the difference between the stored and the currently connected hardware configuration.

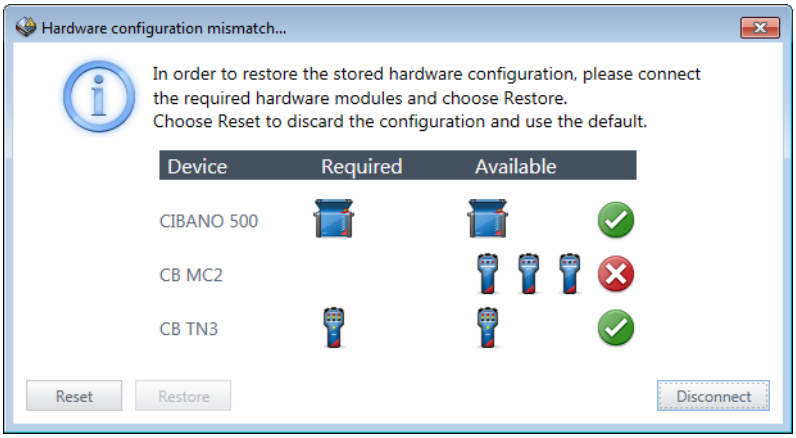


Figure 19-2: Example of the hardware configuration mismatch

Then, do one of the following:

- ► To restore the stored hardware configuration, change the connected configuration to match the hardware configuration of the original test, and then click **Restore**.
- ► Click **Reset** to discard the stored hardware configuration and use the current hardware configuration of the test set with default settings.

  Note: After you click **Reset**, the test will be irreversibly reconfigured with the currently connected hardware configuration.

► Click **Close** to disconnect *Primary Test Manager* from *CIBANO 500*.

19.6 Upgrading the *CIBANO 500* embedded software

If you encounter any problems when upgrading the *CIBANO 500* embedded software in the *Primary Test Manager* home view, we recommend doing it by using the device browser.

To upgrade the *CIBANO 500* embedded software by using the device browser:

1. We recommend exiting *Primary Test Manager* if it is running.
2. Double-click the **OMICRON Devices** icon on the desktop.
3. In the **OMICRON Devices** window, right-click the *CIBANO 500* device you want to upgrade, and then click **Upgrade device** to open the *CIBANO 500* device website in your default web browser.
   In the default web browser, a website with the IP address of the *CIBANO 500* device opens.
4. On the navigation bar, click the flag representing the language you want to use.
5. On the navigation bar, click **Upgrade**, and then click **Select file**.

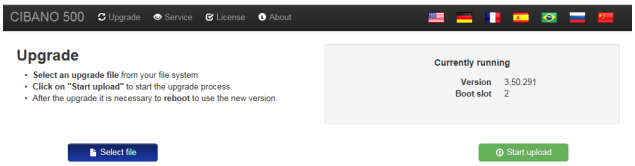


Figure 19-3: Upgrading the *CIBANO 500* embedded software

6. In the **Choose File to Upload** window, browse to the upload file. You can find the upload file:
   - On the *Primary Test Manager* DVD at ._EmbeddedSoftware\Cibano500\embeddedImage.tar
   - On the hard disk of your computer at C:\Program Files (x86)\Common Files\OMICRON\UpgradeImages\CHIMERA\embeddedImage.tar
7. On the device website, click **Start upload**.
8. After the upload has finished, *CIBANO 500* reboots automatically.

   Note: Depending on the browser you are using you may wait up to 30 seconds for a response after you pressed **Start upload**. Sometimes a message may appear that the server does not respond. Ignore this message, after a while the upload will start automatically.
9. If you exited *Primary Test Manager* before upgrading the *CIBANO 500* embedded software, start *Primary Test Manager* again after the upgrade procedure has finished.
10. Connect to the *CIBANO 500* device.

20 Technical data

20.1 Calibration interval of *CIBANO 500*

All input/output values are guaranteed for one year within an ambient temperature of 23 ºC ± 5 ºC/73 ºF ± 10 ºF, a warm-up time longer than 25 min. and in a frequency range of 45 Hz to 65 Hz. Accuracy values indicate that the error is smaller than ±(value read × reading error [rd] + full scale of the range × full scale error [fs]). For mains voltages below 190 V AC the system is subject to power restrictions. Technical data is subject to change without notice.

20.2 *CIBANO 500* specifications

Table 20-1: General output specifications

Characteristic	Rating		
Frequency	DC/15 Hz…400 Hz		
Power	**Vmains**	**$P_{30\ s}$**	**$P_{2\ h}$**
	>100 V	1500 W	1000 W
	>190 V	3200 W	2400 W

Table 20-2: Voltage source (**A** & **B**)

Source	Range	$I_{max,\ 30\ s}$ [1]	$I_{max,\ 2\ h}$ [1]
DC high range	0…±300 V	27.5 A	12 A
DC low range	0…±150 V	55 A	24 A
AC high range	0…240 V	20 A	12 A
AC low range	0…120 V	40 A	24 A

1. Within the power limits specified in Table 20-1: "General output specifications"

Table 20-3: Current source (**A** & **B**)

Source	Range	$V_{max,\ 5\ min}$ [1]	$V_{max,\ 15\ min}$ [1]
DC source	3 × 0…±50 A	50 V	n/a
DC source	3 × 0…±24 A	n/a	50 V

1. Within the power limit specified earlier in this section

The following figures display the output characteristics of *CIBANO 500*.

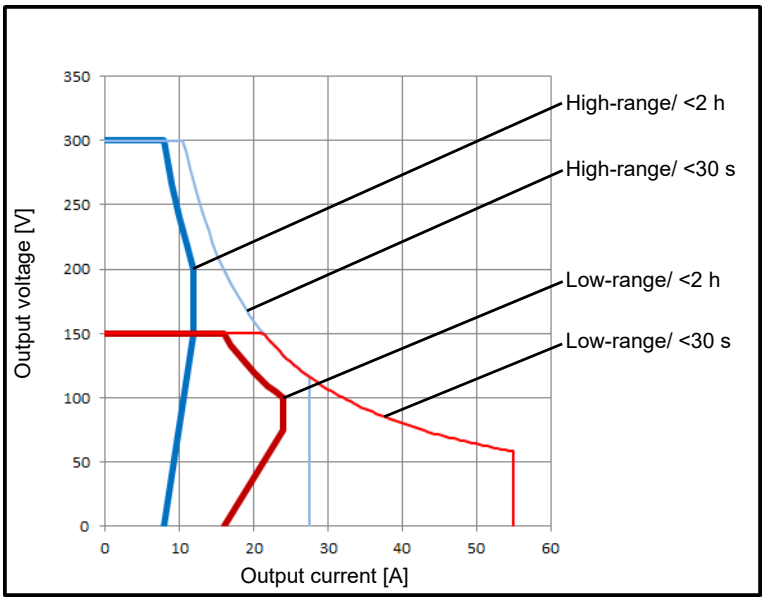


Figure 20-1: DC output characteristics

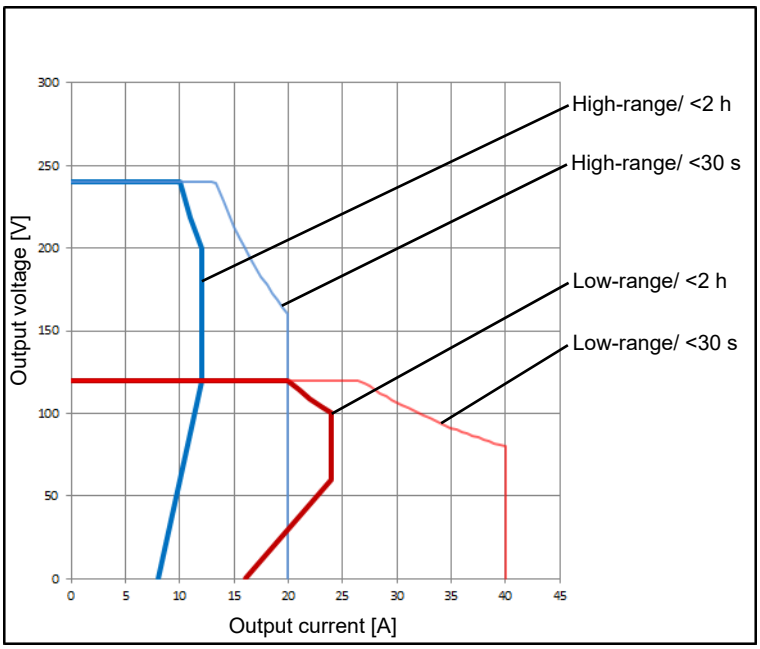


Figure 20-2: AC output characteristics

The CAT level required depends on the *CIBANO 500* application. All CAT ratings are defined for sea levels below 2000 m. There are some limitations between 2000 m and 5000 m sea level.

CAT I is required when the measured voltage is generated by the test set itself. No voltages from other sources are measured. When measuring on circuit breakers that are fully disconnected from the substation installation CAT I would be sufficient.

CAT II is required when measuring within electrical devices or between mains supply and devices.

CAT III is required when measuring in electrical installations such as control cubicles that are still connected to the station battery or mains. The electrical installations are protected by a fuse.

Table 20-4: Internal measurement of outputs **A (CAT III / 300 V)**[1]

Range name	Range value	Accuracy[2]
300 V	0…300 V	DC: 0.1% rd + 0.05% fs AC: 0.03% rd + 0.01% fs

1. For limited specifications, see Table 20-18: "Climate" on page 254.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-5: Internal measurement of outputs **B (CAT III / 300 V)**[1]

Range name	Range value	Accuracy[2]
300 V	0…300 V	DC: 0.1% rd + 0.05% fs AC: 0.03% rd + 0.01% fs
3 V	0…3 V	DC: 0.1% rd + 0.05% fs
300 mV	0…300 mV	DC: 0.1% rd + 0.1% fs
30 mV	0…30 mV	DC: 0.1% rd + 0.1% fs

1. For limited specifications, see Table 20-18: "Climate" on page 254.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-6: Internal measurement of outputs

Range name	Range value	Accuracy[1]
55 A	0…55 A	DC: 0.1% rd + 0.2% fs
40 A	0…40 A	AC: 0.1% rd + 0.1% fs

1. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-7: Resistance measurement

Range name	Range value	Meas. current	Accuracy[1]
30 mV	0.1 µΩ…300 µΩ	100 A	0.2% rd + 0.1 µΩ
300 mV	0.5 µΩ…3000 µΩ	100 A	0.2% rd + 0.5 µΩ
3 V	5 µΩ…30 mΩ	100 A	0.2% rd + 5 µΩ
3 V	50 µΩ…300 mΩ	10 A	0.2% rd + 50 µΩ

1. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-8: Timing accuracy

Characteristic	Rating
Timing accuracy	±1 sample interval ±0.01% rd

Table 20-9: Voltage input **V IN (CAT III / 300 V)**[1]

Input	Range	Accuracy[2]
DC input	0…420 V	0.5% rd + 0.5% fs
AC input	0…300 V	0.5% rd + 0.5% fs

1. For limited specifications, see Table 20-18: "Climate" on page 254.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-10: Binary input **A (CAT III / 300 V)**[1]

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 µs

1. For limited specifications, see Table 20-18: "Climate" on page 254.

Table 20-11: Interfaces

Interface	Rating
Digital	2 × safety dongle, 1 × serial, 1 × Ethernet EtherCAT® module: 4 × EtherCAT® Auxiliary module: 1 × EtherCAT®, 3 × binary input (C)
Analog	1 × analog input (V IN) 3 × analog input/analog output/binary input (A) 4 × analog input/analog output (B) Auxiliary module: 3 × binary input (C)

20.2.1 Commands

The commands for trip, close and motor can be routed to up to three output sockets in section **A** or **B**.

Table 20-12: Specifications when internal supply is used

Typical voltage drop = 3 V		
Command	**Max. current[1]**	**Duty cycle**
Trip/Close/Supply	6 A_{RMS} AC or DC	Continuous
	15 A_{RMS} AC or DC	20 s on, 80 s off
	30 A_{RMS} AC or DC	10 s on,190 s off
	40 A_{RMS} AC or 55 A DC	200 ms
Motor	24 A_{RMS} AC or DC	Continuous
	40 A_{RMS} AC or DC	20 s on, 80 s off
	55 A DC	10 s on,190 s off

1. Valid while using one channel. Thermal derating when 2 or 3 channels are used in parallel.

Table 20-13: Specifications when external supply is used

Command	**Max. current[1]**	**Duty cycle**
Trip/Close/Supply/Motor	24 A_{RMS} AC or DC	Continuous
	40 A_{RMS} AC or DC	20 s on, 80 s off
	55 A DC	10 s on,190 s off

1. Valid while using one channel. Thermal derating when 2 or 3 channels are used in parallel.

20.2.2 EtherCAT® interface

For the maximum use case of the EtherCAT®-based accessories, you can connect up to twelve *CB MC2* modules, one *CB TN3* module and up to three *IOB1* modules. In this case, the default sample rate of 10 kHz and the recommended system setup for *Primary Test Manager* (see 2 "System requirements" on page 13) have to be used.

20.2.3 Auxiliary module

Table 20-14: Voltage input **C (CAT III / 300 V)**[1]

Input	Range	Accuracy[2]
DC input	0…420 V	0.5% rd + 0.1% fs
AC input	0…300 V	0.5% rd + 0.1% fs

1. For limited specifications, see Table 20-18: "Climate" on page 254.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 20-15: Binary input **C (CAT III / 300 V)**[1]

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 µs

1. For limited specifications, see Table 20-18: "Climate" on page 254.

Table 20-16: Interfaces

Interface	Rating
Digital	1 × EtherCAT®
Analog	3 × binary input

20.3 Power supply specifications

Table 20-17: Power supply specifications

Characteristic		Rating
Voltage	Nominal	100 V…240 V AC
	Permitted	85 V…264 V AC
Current	Nominal	16 A
Frequency	Nominal	50 Hz/60 Hz
	Permitted	45 Hz…65 Hz
Power fuse		Automatic circuit breaker with magnetic overcurrent tripping at I >16 A
Power consumption	Continuous	<3.5 kW
	Peak	<5.0 kW
Connector type		IEC320/C20, 1 phase

20.4 Environmental conditions

Table 20-18: Climate

Characteristic		Rating
Temperature	Operating	–10 ºC…+55 ºC/+14 ºF…+131 ºF
	Storage	–30 ºC…+70 ºC/–22 ºF…+158 ºF
Max. altitude	Operating	2000 m/6550 ft, up to 5000 m/16400 ft with limited specifications[1,2]
	Storage	12 000 m/40 000 ft

1. Voltage inputs **V IN (CAT III / 300 V)** and **C (CAT III / 300 V)**: from 2000 m/6550 ft to 5000 m/16400 ft altitude CAT III compliance only with half voltage
2. Outputs **A (CAT III / 300 V)** and **B (CAT III / 300 V)** and binary inputs **A (CAT III / 300 V)** and **C (CAT III / 300 V)**: from 2000 m/6550 ft to 5000 m/16400 ft altitude only CAT II compliance or CAT III compliance with half voltage

20.5 Mechanical data

Table 20-19: Mechanical data

Characteristic	Rating
Dimensions (w × h× d)	580 mm × 386 mm × 229 mm/22.9 inch × 15.2 inch × 9.0 inch (w = 464 mm/18.3 inch without handles)
Weight	20 kg/44.1 lb

20.6 Standards

Table 20-20: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	TÜV SÜD TÜV SÜD C US
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz…150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation), tested at 40 ºC/104 ºF for 48 hours	

21 Accessories

21.1 *CB MC2* module

21.1.1 Designated use

The *CB MC2* module is a probe for timing, static and dynamic resistance measurements on the circuit breaker's main contacts. It facilitates measurements where current is injected over the circuit breaker interrupter while the circuit breaker is operated (tripped or closed).

Figure 21-1: Front view of the *CB MC2* module

Two green LEDs indicating the EtherCAT® state.
RUN: Signals the state of the EtherCAT® state machine.
L/A: Signals the state of the physical link and activity on this link.
LEDs with the same functionality are also on the side panel of *CIBANO 500* (see 3.2.2 "Side panel" on page 16.)

EtherCAT® connector for connecting the *CB MC2* to *CIBANO 500*

Figure 21-2: Bottom view of the *CB MC2* module

21.1.2 Technical data

Table 21-1: *CB MC2* specifications

Characteristic	Rating
Current output	
Number of channels	2
Current source	0…100 A DC
Maximum output voltage	2.6 V DC
Static contact resistance measurement	
Range	0.1 µΩ…1000 µΩ
Accuracy[1]	0.2% rd + 0.1 µΩ
Measuring current	100 A
Dynamic contact resistance measurement[2]	
Range	10 µΩ…200 mΩ
Accuracy[1]	0.2% rd + 10 µΩ
Settling time	40 µs
Maximum sample rate	40 kHz
Minimum resolution	25 µs
Pre-insertion resistance (PIR) measurement	
Range	0…10 kΩ
Accuracy (<500 Ω)[1]	0.5% rd + 10 mΩ
Accuracy (500 Ω…10 kΩ)[1]	3% rd
Timing measurement	
Maximum sample rate	40 kHz
Minimum resolution	25 µs
Accuracy	±1 sample interval ±0.01% rd
Interface	
Communication protocol	EtherCAT®
Connector type	RJ-45

1. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.
2. Valid for test currents ≥10 A

Table 21-2: Maximum output current duration with a fully charged capacitor[1]

Output current	Load		
	100 µΩ	500 µΩ	3 mΩ
1 × 100 A	6200 ms	5960 ms	4460 ms
2 × 100 A	1900 ms	1780 ms	1030 ms

1. Only valid if the standard 3 m red and 0.75 m black high-current cables are used.

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 21-3: Climate

Characteristic		Rating
Temperature	Operating	–30 ºC…+70 ºC/–22 ºF…+158 ºF
	Storage	–30 ºC…+70 ºC/–22 ºF…+158 ºF
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 21-4: Mechanical data

Characteristic	Rating
Dimensions (w × h× d)	109 mm × 272 mm × 63 mm/ 4.3 inch × 10.7 inch × 2.5 inch
Weight	1.2 kg/2.6 lb

Table 21-5: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1	TÜV SÜD
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz…150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation), tested at 40 ºC/104 ºF for 48 hours	
Protection class	IP 42 (only in the pendent position), according to IEC/EN 60529	

21.2 *CB TN3* module

21.2.1 Designated use

The *CB TN3* module is used to evaluate the displacement of the circuit breaker's main contacts during operation. The contact travel is measured by transducers connected to the *CB TN3* module. The *CB TN3* module supports digital and analog transducers.

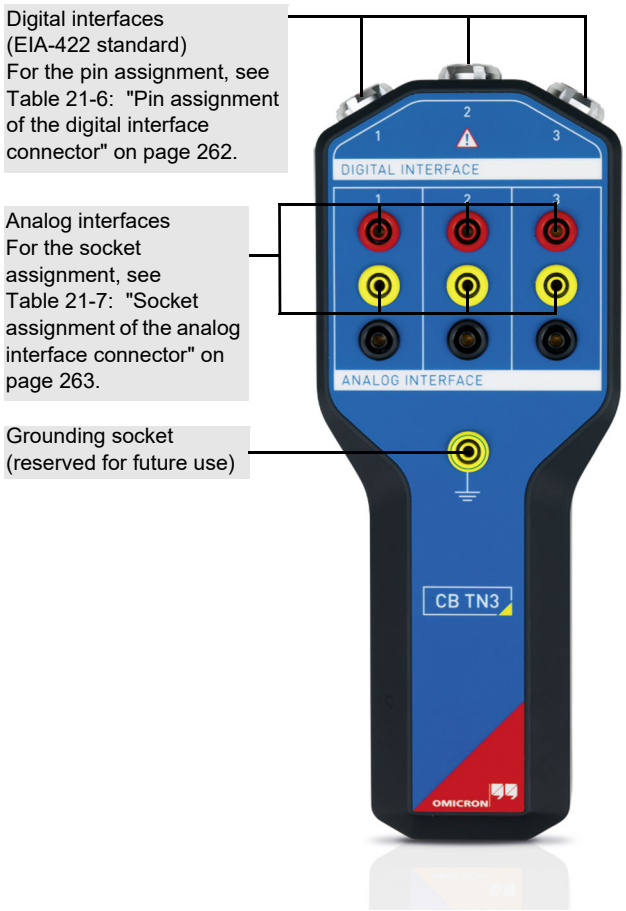


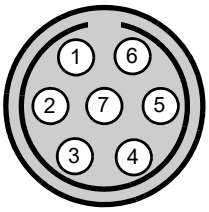
Figure 21-3: Front view of the *CB TN3* module

Two green LEDs indicating the EtherCAT® state.
RUN: Signals the state of the EtherCAT® state machine.
L/A: Signals the state of the physical link and activity on this link.
LEDs with the same functionality are also on the side panel of *CIBANO 500* (see 3.2.2 "Side panel" on page 16.)

EtherCAT® connector for connecting the *CB TN3* to *CIBANO 500*

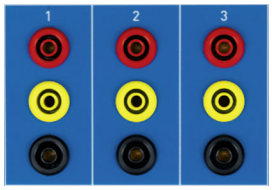
Figure 21-4: Bottom view of the *CB TN3* module

Table 21-6: Pin assignment of the digital interface connector

Layout	Pin	Description
	**Differential signals**	
	1	A
	2	!A[1]
	3	B
	4	!B[1]
	Supply voltage	
	5 (reserved for future use)	+5 V
	6	+5 V…+30 V (set by the user in *Primary Test Manager*)
	Grounding	
	7	GND

1. Inverted signal

Table 21-7: Socket assignment of the analog interface connector

Layout	Socket	Channel	Description
	Red	1	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND
	Red	2	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND
	Red	3	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND

21.2.2 Technical data

Table 21-8: *CB TN3* specifications

Characteristic	Rating
Max. number of digital/analog transducers used simultaneously	3
Interface to *CIBANO 500*	
Communication protocol	EtherCAT®
Connector type	RJ-45

Table 21-9: Analog transducer interface

Characteristic	Rating
Output	
Number of channels	3
Voltage	5 V…30 V DC
Current	10 mA…50 mA
Voltage input	
Number of channels	3
Range	30 V
Accuracy[1]	0.1% rd + 20 mV
Maximum sample rate	40 kHz
Minimum resolution	25 µs
Current input	
Number of channels	3
Range	50 mA
Accuracy[1]	0.1% rd + 20 µA

1. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 21-10: Digital transducer interface

Characteristic	Rating
Output	
Number of channels	3
Voltage	5 V…30 V DC
Current	10 mA…200 mA
Max. power per channel	5 W
Input	
Input signal	2 square-wave signals according to EIA-422/485 standard
Max. input frequency	10 MHz
Maximum sample rate	40 kHz
Minimum resolution	25 µs
Accuracy	±1 pulse ±0.01% rd

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 21-11: Climate

Characteristic		Rating
Temperature	Operating	–30 ºC…+70 ºC/–22 ºF…+158 ºF
	Storage	–30 ºC…+70 ºC/–22 ºF…+158 ºF
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 21-12: Mechanical data

Characteristic	Rating
Dimensions (w × h× d)	109 mm × 272 mm × 63 mm/4.3 inch × 10.7 inch × 2.5 inch
Weight	0.76 kg/1.7 lb

Table 21-13: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1	TÜV SÜD
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz…150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation), tested at 40 ºC/104 ºF for 48 hours	
Protection class	IP 42 (only in the pendent position), according to IEC/EN 60529	

21.3 *IOB1* module

21.3.1 Designated use

The *IOB1* module extends the amount of inputs and outputs of *CIBANO 500*. It provides 12 completely independent galvanically isolated channels (CAT III / 300 V). The additional inputs and outputs can be used for reading auxiliary contacts and controlling trip and close coils and motors.

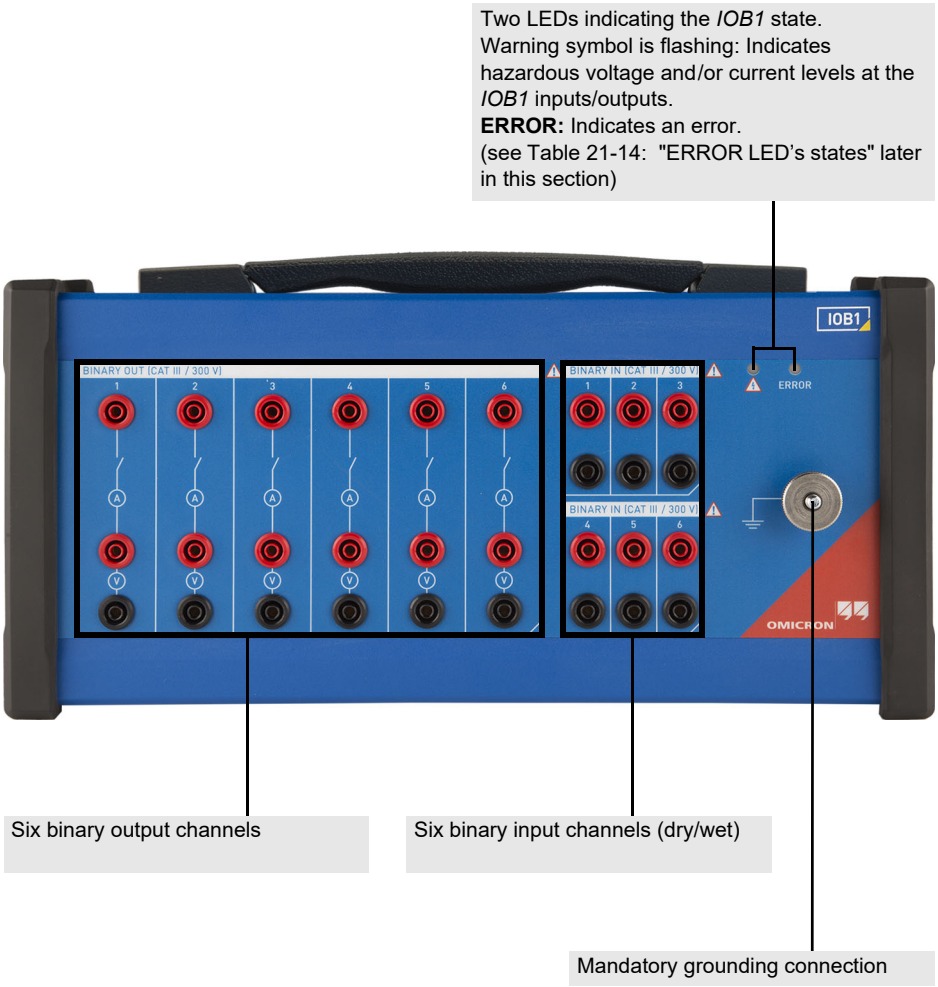


Figure 21-5: Front view of the *IOB1* module

Table 21-14: **ERROR** LED's states

State	Description
Off	No error
Flashes periodically two times	Supply failure of the channel relay
Flashes periodically three times	Overtemperature

The following figures show the output and input channel configurations.

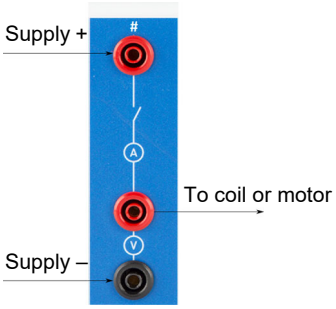


Figure 21-6: Output channel configuration

The contacts of the output channels are controlled by *CIBANO 500* according to the specified test sequence. Each output channel has an integrated voltage and current measurement. Because of the integrated voltage measurement, the output channels can also be used to detect the state of an auxiliary contact. The output channels are externally supplied, for example, via the **B3**/**BN** output of *CIBANO 500*.

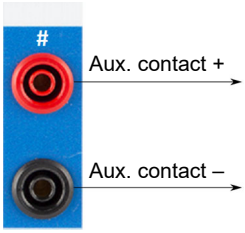


Figure 21-7: Input channel configuration

The input channels are used to detect the state of an auxiliary contact. These contacts can have a voltage supplied to them (wet) or can be potential free (dry).

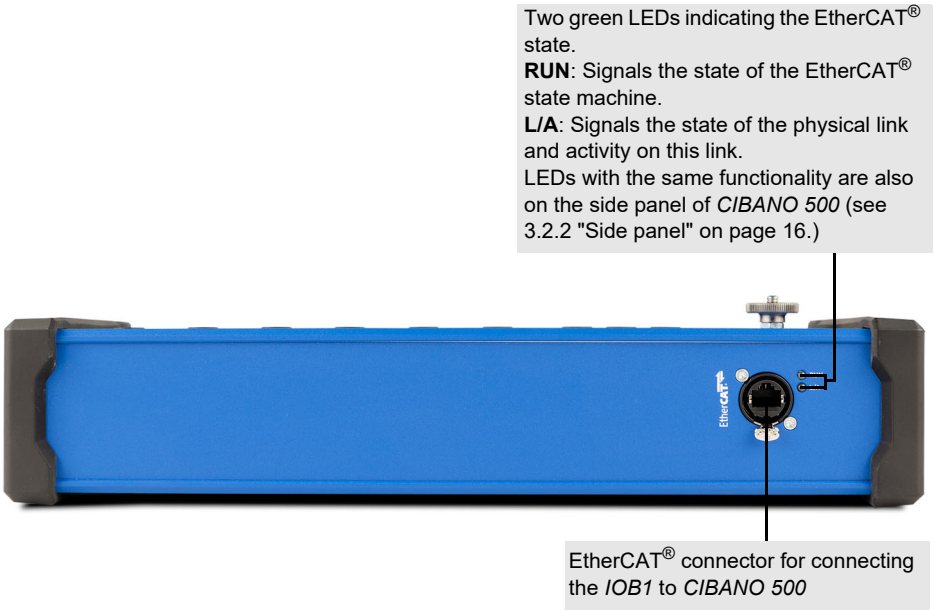


Figure 21-8: Bottom view of the *IOB1* module

21.3.2 Technical data

Table 21-15: Voltage measurement on **BINARY OUT/BINARY IN (CAT III / 300 V)**[1]

Signal type	Measurement range	Accuracy[2]
DC, continuous	300 V	0.05% rd + 0.05% fs
AC, continuous		0.05% rd + 0.02% fs

1. For limited specifications, see Table 21-21: "Climate" on page 270.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 21-16: Current measurement on **BINARY OUT (CAT III / 300 V)**[1]

Signal type	Measurement range	Accuracy[2]
DC, continuous	40 A	0.1% rd + 0.2% fs
AC, continuous		0.1% rd + 0.05% fs

1. For limited specifications, see Table 21-21: "Climate" on page 270.
2. Means “typical accuracy”; 98% of all units have an accuracy which is better than specified.

Table 21-17: Voltage rating on **BINARY OUT/BINARY IN (CAT III / 300 V)**[1]

Voltage per channel	Duty cycle
±300 V DC or AC	continuous
±500 V	transient peak

1. For limited specifications, see Table 21-21: "Climate" on page 270.

Table 21-18: Current rating on **BINARY OUT (CAT III / 300 V)**[1]

Current per channel	Duty cycle
24 A_{RMS} DC or AC	continuous
40 A_{RMS} AC or 55 A_{peak}	200 ms on, 5 s off
±85 A	transient peak

1. For limited specifications, see Table 21-21: "Climate" on page 270.

Table 21-19: Timing accuracy

Characteristic	Rating
Timing accuracy	±1 sample interval ±0.01% rd

Table 21-20: **BINARY IN (CAT III / 300 V)**[1]

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 µs

1. For limited specifications, see Table 21-21: "Climate" on page 270.

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 21-21: Climate

Characteristic		Rating
Temperature	Operating	–10 ºC…+55 ºC/+14 ºF…+131 ºF
	Storage	–30 ºC…+70 ºC/–22 ºF…+158 ºF
Max. altitude	Operating	2000 m/6550 ft, up to 5000 m/16400 ft with limited specifications[1]
	Storage	12 000 m/40 000 ft

1. **BINARY OUT (CAT III / 300 V)** outputs and **BINARY IN (CAT III / 300 V)** inputs: from 2000 m/6550 ft to 5000 m/16400 ft altitude only CAT II compliance or CAT III compliance with half voltage

Table 21-22: Mechanical data

Characteristic	Rating
Dimensions (w × h× d)	381 mm × 190 mm × 90 mm/15 inch × 7.5 inch × 3.5 inch
Weight	3.0 kg/6.6 lb

Table 21-23: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	TÜV SÜD
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz…150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation), tested at 40 ºC/104 ºF for 48 hours	

21.4 *EHB1* EtherCAT® hub

21.4.1 Designated use

The *EHB1* EtherCAT® hub is a module for connecting OMICRON accessories like the *CB MC2*, *CB TN3* and *IOB1* modules to *CIBANO 500* EtherCAT® interface.

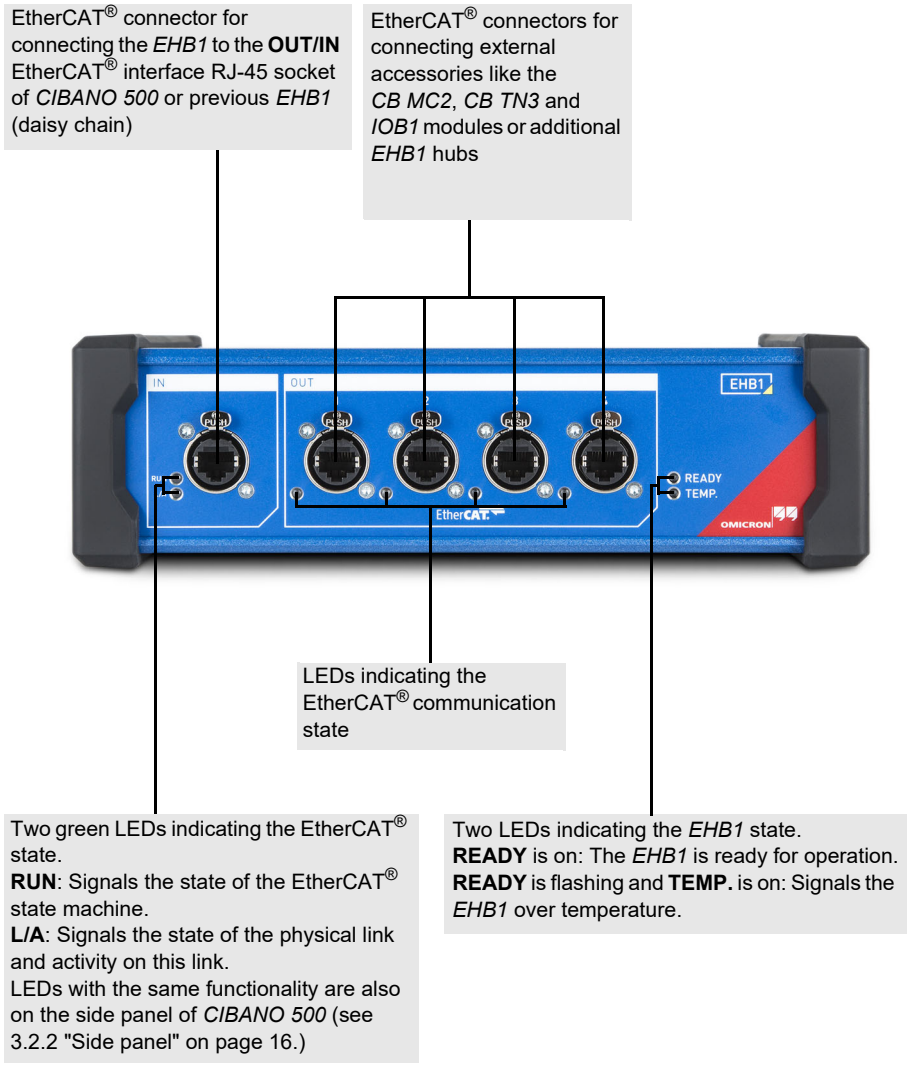


Figure 21-9: Front view of the *EHB1* EtherCAT® hub

21.4.2 Technical data

Table 21-24: *EHB1* communication specifications

Characteristic	Rating
Output	
Number of channels	4
Devices per channel	1×*CB MC2*, 1×*CB TN3* or 1×*IOB1*
Max. cable length	100 m/328 ft
Input	
Number of channels	1
Interface	
Communication protocol	EtherCAT®
Connector type	RJ-45

Table 21-25: Power supply specifications

Characteristic		Rating
Voltage	Nominal	100 V…240 V AC
	Permitted	85 V…264 V AC
Current	Maximal	2.5 A
Frequency	Nominal	50 Hz/60 Hz
	Permitted	45 Hz…65 Hz
Connector type		IEC320/C14, 1 phase

Table 21-26: Climate

Characteristic		Rating
Temperature	Operating	–10 ºC…+55 ºC/+14 ºF…+131 ºF
	Storage	–30 ºC…+70 ºC/–22 ºF…+158 ºF
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 21-27: Mechanical data

Characteristic	Rating
Dimensions (w × h× d)	265 mm × 80 mm × 180 mm/10.4 inch × 3.1 inch × 7.1 inch
Weight	1.8 kg/4.0 lb

Table 21-28: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1	TÜV SÜD
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz…150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation), tested at 40 ºC/104 ºF for 48 hours	

21.5 Current sensor

21.5.1 Designated use

The current sensor is used to measure the operating times on both-side grounded gas insulated switchgears (GIS) with grounding switches. During the dedicated Timing (GIS) test (see 17.3.4 "Timing (GIS) test" on page 193) the sensor detects the change of current flow through the measured ground connection of the grounding switch. The current sensor is only intended to be used with the *CIBANO 500* test system.

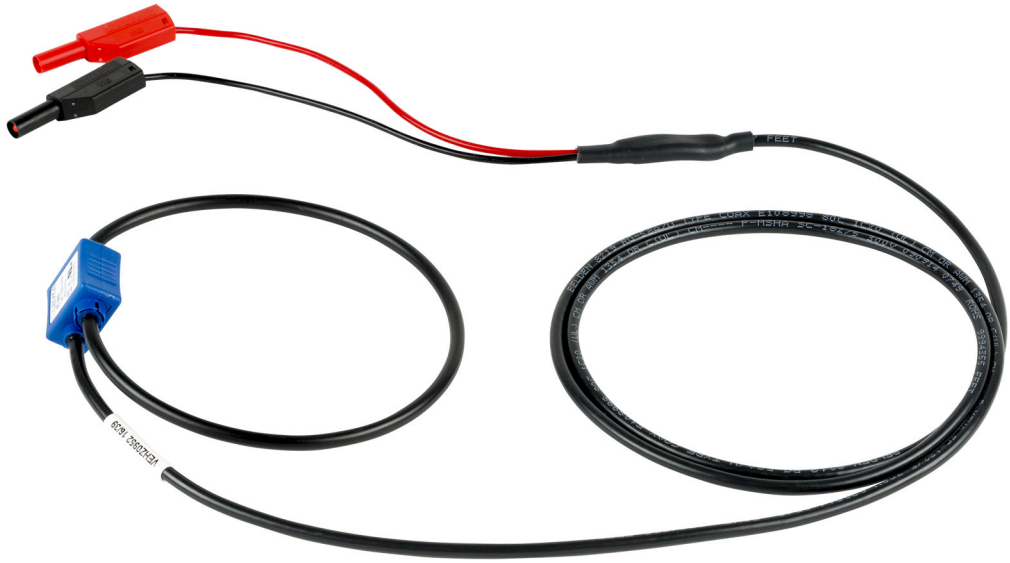


Figure 21-10: Current sensor

21.5.2 Technical data

Table 21-29: Current sensor specifications

Characteristic	Rating
Primary nominal RMS current	2.000 A
IP class	IP 2X

22 Software license information

Parts of the *CIBANO 500* software are under OMICRON license, other parts are under open source software licenses.

The following OMICRON licenses are available for activating the corresponding tests and software features:

- Dynamic Contact Resistance
- Timing
- Current Sensor Measurement
- Contact Resistance
- Minimum Pickup
- Motor Current
- Current clamp
- Motion
- Demagnetization

22.1 Manage OMICRON licenses

To manage the OMICRON licenses for a *CIBANO 500* device:

1. Double-click the **OMICRON Devices** icon  on the desktop.
2. In the **OMICRON Devices** window, right-click the *CIBANO 500* device in the list, and then click **Upgrade device** to open the *CIBANO 500* device website.
3. On the navigation bar, click the flag representing the language you want to use.
4. On the navigation bar, click **License** to display the list of available licenses.

22.2 Upload a license file

To upload a license file:

1. On the *CIBANO 500* device website, click **Select file**.
2. In the **Choose File to Upload** window, browse to the license file you want to upload.
3. On the device website, click **Start upload**.

22.3 Read the open source licensing information

For the complete open source licensing information:

1. Open the *CIBANO 500* device website.
2. On the navigation bar, click **About**, and then click **Manifest**.

The open source code is available at www.omicronenergy.com/opensource.

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The customer area on our website is an international knowledge exchange platform. Download the latest software updates for all products and share your own experiences in our user forum.

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